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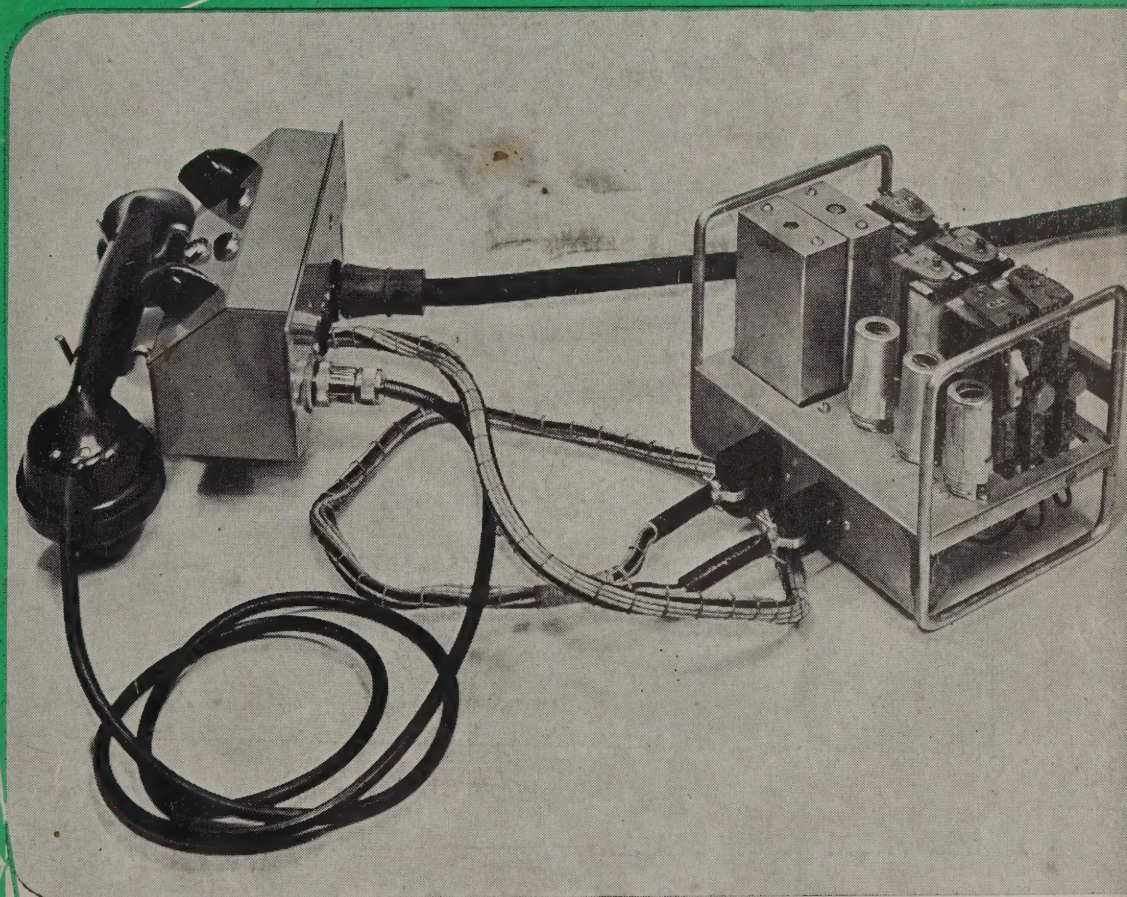

In this issue:

An Englishman on T.V.

A Six-valve Battery Receiver.

Selective Calling on Radio Telephone Systems.

January, 1st, 1953 VOL. 7, NO. 11. 1/10

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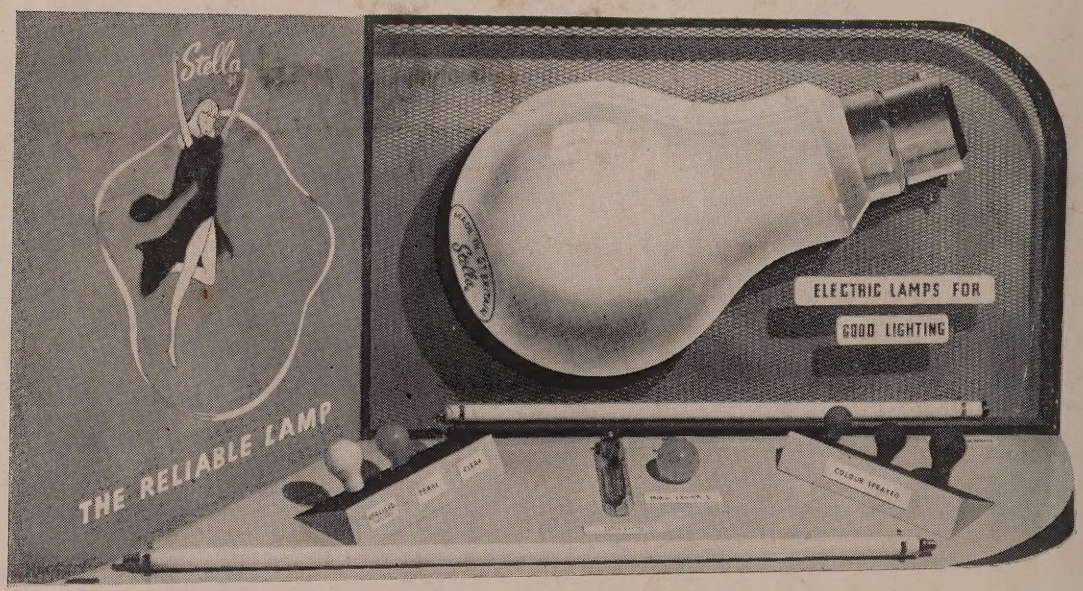

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Radio and Electronics

OUR COVER this month illustrates the control-box, hand-set, and the calling equipment described in the article to be found in this issue. The photograph gives a good idea of the small amount of gear needed to add selective calling facilities to a standard mobile communication station.

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All correspondence and contributions should be addressed to:

The Editor,
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New Light On High-Fidelity

To those interested in this evergreen topic, the chapter in the latest edition of the Radiotron Designer's Handbook which deals with it will be found most valuable and entertaining. In view of the volumes of material that have been written, and of the endless discussion which takes place whenever two or three interested persons are found together, the collection in one chapter of all the relevant conclusions that are currently held in authoritative quarters should do much to dispel some of the air of mystery that surrounds some of the information.

Perhaps the most interesting part of Mr. Langford-Smith's discussion is the section referring to permissible distortion levels, and to the methods that may be used for determining the effect on the listener of varying quantities of harmonic and intermodulation distortion. It may come as a shock, for instance, to learn that if a true comparison is to be made between different sound systems, not only the frequency characteristics must be measured, but so also must all harmonics up to and including the thirteenth. When measurements of intermodulation distortion are made, it is important to note that the results can only be compared with harmonic distortion measurements on a basis of "weighting" the harmonics. That is to say, an amplifier which produces five per cent. second harmonic, produces the same intermodulation distortion as 0.77 per cent. thirteenth harmonic. This is rather a sobering thought!

Another interesting conclusion which can be drawn from the figures quoted in the text is that triodes really are better than pentodes. The authority for this statement (which is ours, and not Mr. Langford-Smith's) is none other than the American worker Olson, who has done more work than anyone else in an attempt to find a basis on which measurements of amplifiers would indicate the same order of "goodness" as can be arrived at by actual listening tests. Olson states that for a single Class A triode, harmonics higher than the fourth can be neglected as far as their effect on the listener is concerned, while with pentodes, even the thirteenth harmonic can produce observable effects. The addition of negative feedback does not alter the relative amounts of the harmonics produced by any amplifier, but affects all of them to the same degree. Thus, if a pentode amplifier is compared with a triode one, it is clear that a good deal of negative feedback must be used on the former before it becomes as good as the triode without any feedback at all. By the same token, if the same amount of feedback is applied to both, the triode will remain superior to the pentode.

In the case of push-pull triodes or pentodes, the difference is not so marked. This is because any properly-designed push-pull amplifier largely cancels out the even harmonics, leaving only the odd ones. In the case of pure Class A triodes, the result must be an improvement on the single-ended one, since the even harmonics are eliminated without any other effects coming into play. But if the triodes are over-biased, bringing them towards Class AB operation, some of their superiority is lost, because increasing the bias causes some of the higher odd harmonics to make their appearance, and these cannot be eliminated by the push-pull connection. Thus, if strictly Class A conditions are adhered to, it appears that push-pull triodes retain their superiority over pentodes.

This might well be the answer to the age-old belief that whatever instruments may say, there is "something about" pentodes that does not sound quite right.

We have all heard that the wider the frequency range, the more objectionable does a given amount of distortion become. Here, however, we have quantitative proof of this assertion. In listening tests, it has been found that just perceptible distortion, with an upper frequency limit of 15,000 c/sec., is represented by 0.75 per cent. total harmonic distortion. For a top limit of 7,500 c/sec., 0.95 per cent. is just perceptible. For tolerable distortion, which by definition is the amount which could be allowed for *low-grade* commercial sound equipment, 1.8 per cent. is a representative figure for a system with a 15,000 c/sec. limit, and 4.4 per cent. for a 7,500 c/sec. limit. The remarkable thing about these figures is that for distortion to be barely perceptible, the amount does not vary much for systems with widely different top frequencies. For a top limit of only 3,750 c/sec., the perceptible distortion is only 1.2 per cent., which is not even twice as much as for the 15,000-cycle system.

These few facts and figures do not in themselves prove very much. Indeed, in some ways they are contradictory, as those who read the chapter referred to will realize, but they do indicate that there is a good deal more in this high-fidelity business than meets the eye, and that a good deal yet remains to be discovered. There is a good deal more than we have had space to mention here in the treatise we have discussed, but enough should have been said to show that Mr. Langford-Smith has once again given us more than a little to think about.

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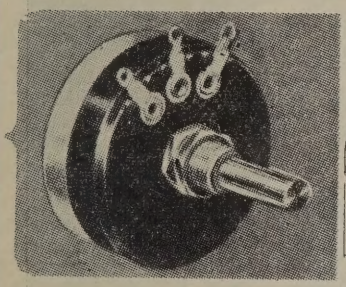

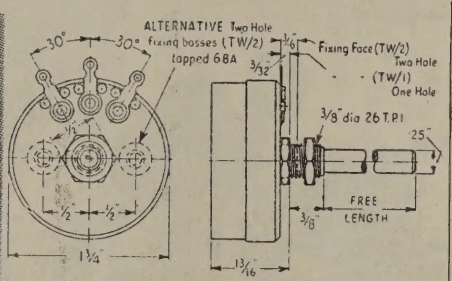

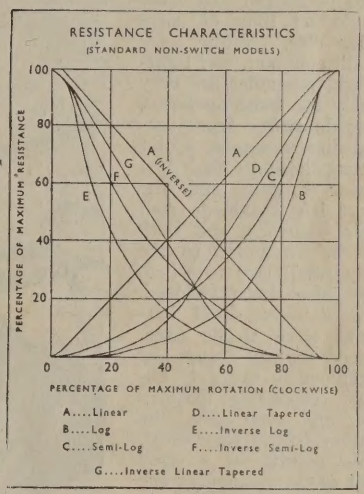

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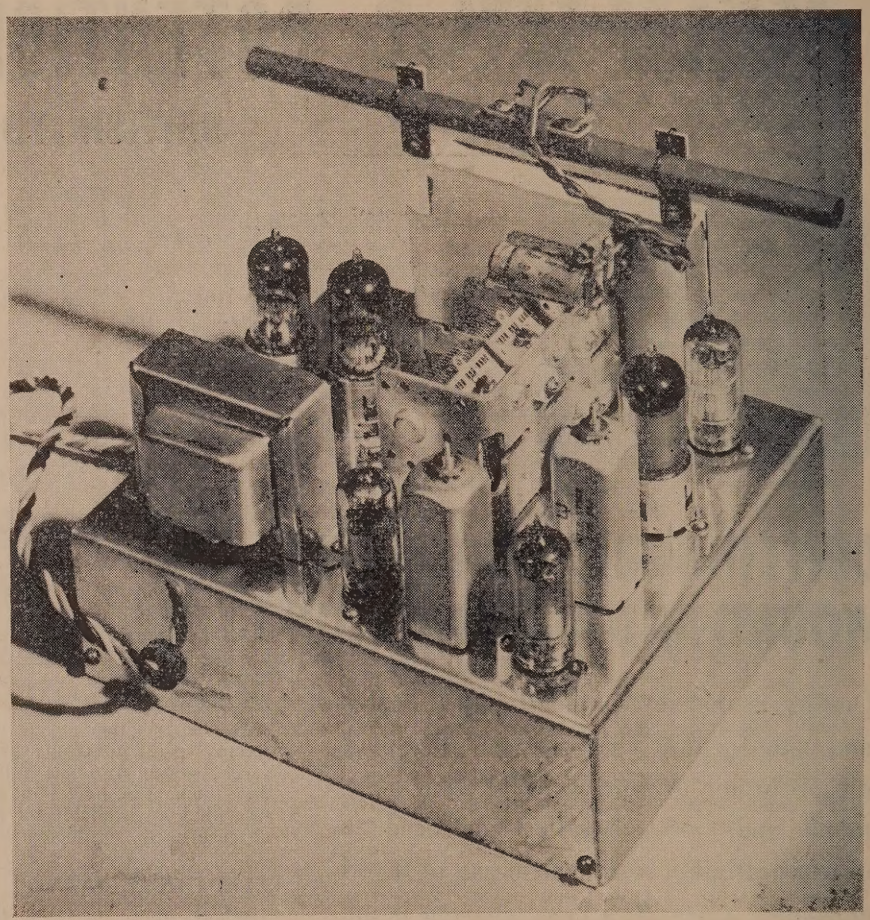
A Novel Six-Valve Battery Receiver

While the demand for large battery sets is very much smaller now than it was at one time, it was thought that a six-valve circuit which could be built into either portable form or into a small mantel set would be popular for many purposes. The circuit described in this article has a number of features that will appeal to those who find the average small portable circuit unsuited to their needs.



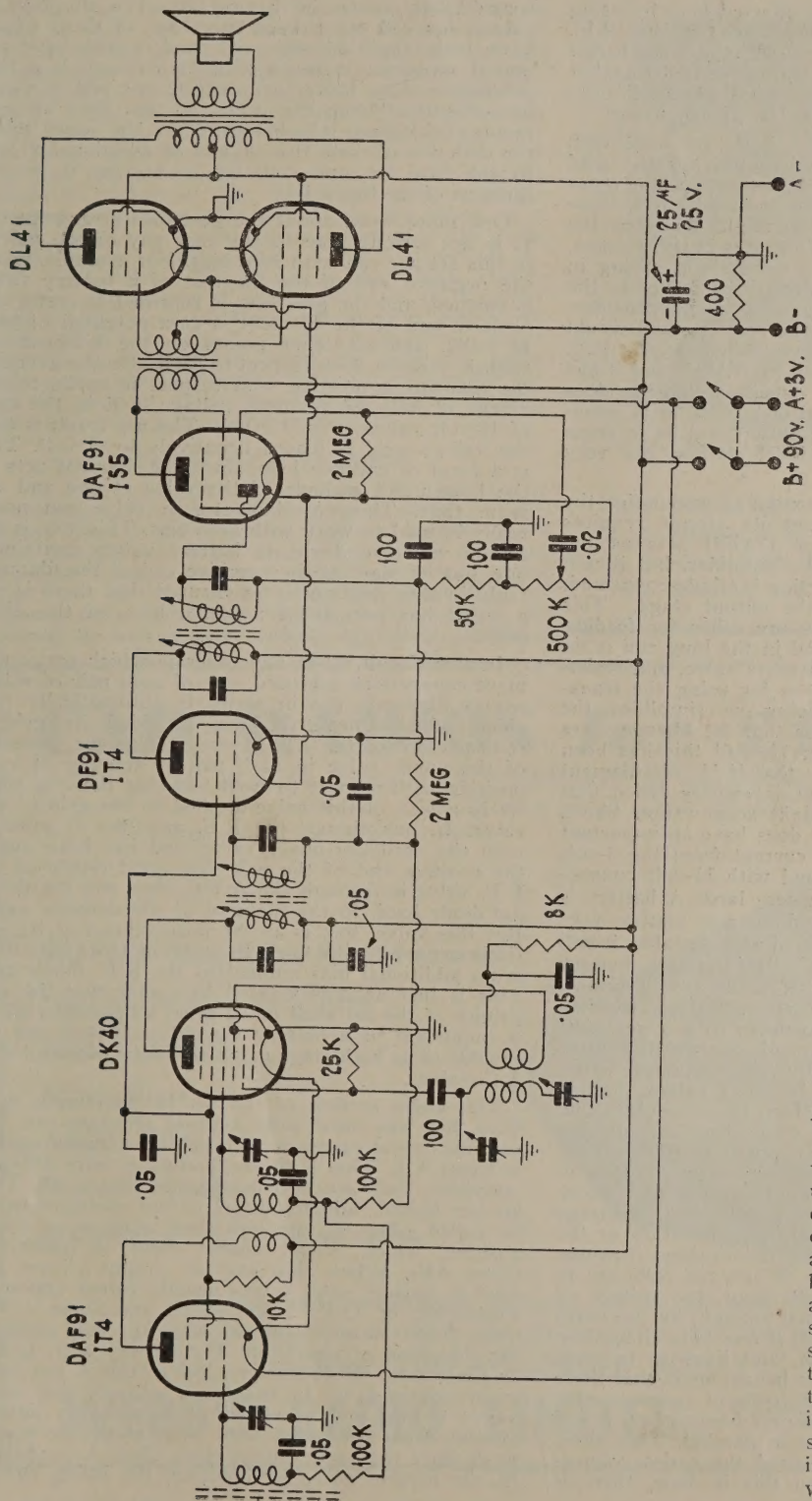
INTRODUCTION

With the advent of miniature battery valves, the accent in portable design has quite understandably been rather on miniaturization of the whole set than on anything else. While very small, compact, and lightweight portables are very handy for some purposes, they do suffer from several disadvantages. Chief among these are their low power output, and the short life obtained from their batteries, and both can be attributed to the very small size to which they have been reduced. Where very small batteries have to be used, power output must ..be sacrificed in order to obtain reasonable battery life, and even then, the battery life is very short. This results in a good deal of annoyance to the user, not to mention expense, since the miniature batteries are very much more expensive, in terms of their capacity, than are the larger ones that can be used if the set does not have to be so small in dimensions.

The question of the power output, too, is rather a vexed one. We have heard several complaints from non-technical users of small commercial portables that they distort badly—and so they do—the reason being that before the output tube has produced enough noise to satisfy one who is used to a set with a power output of several watts, the unfortunate output valve, whose undistorted output is in the region of only 200 milliwatts, is grossly overloaded.

Both these defects of the ultra-small portable can be overcome if one is prepared to have a slightly larger set, containing bigger batteries, and with a valve or valves in the output stage that will give upwards of half a watt of output power. It was with this object in view that the present receiver was designed. In spite of a high power output of almost half a watt, the set uses only 90 volts of B battery, and draws approximately 12 ma. when idling. (i.e., not tuned to a station).

In addition, the sensitivity is extremely good, owing partly to the use of an R.F. amplifier, and partly to a form of aerial that is entirely new, and that very few readers will have come across. This "rod" aerial has the same characteristics as the conventional loop aerial, in that it is directional, and can be used as the first tuned circuit in the receiver, just as a loop is. But it does more than just replace the loop aerial. It takes up a good deal less space, and yet is equivalent, as far as signal pick-up is concerned, to a loop measuring approximately 5 in. x 9 in. In addition, its Q is considerably higher than that of the loop, which makes the selectivity of the receiver's input circuit rather better. But there is one advantage possessed by the rod aerial, which makes it infinitely more desirable than a loop in a portable receiver. It does not



introduce instability through undesired coupling to the remainder of the receiver, and results in a very stable receiver indeed. This is a feature which will be welcomed by manufacturers and amateur constructors alike, since a great deal of instability trouble has been experienced simply because the compact nature of the cabinet made it necessary to place the loop aerial too close to the set.

The results obtained in our laboratory with this rod aerial were little short of amazing. Our outside aerial, though high and long, picks up so much interference that noise can even be heard on 2YA, though it is not strong enough to cause annoyance. Nevertheless, it can be heard, and the noise is so strong that 3YA is almost lost in it, while 4YA is inaudible. Using the rod aerial, however, the noise was so greatly reduced in magnitude that even 4YA became readable, while 3YA was vastly improved, and on the local stations, no trace at all could be heard of the noise that broke through when the outside aerial was used.

CIRCUIT

One pleasing feature of most battery-operated receivers is the small number of components contained even in quite a large circuit. This can be accounted for (a) by the lack of the normal A.C. power supply, and (b) by the fact that relatively few different voltages are required for the elements of the valves. In some cases, especially where low H.T. voltages are used, there are no screen-grid dropping resistors or bypass condensers, since the screens are connected directly to the battery. Similarly, grid bias arrangements are usually considerably simpler than in A.C. sets. As a result of all this, the present set contains relatively few small components, in spite of the fact that the screen grids of the R.F. valves in this case need only 67.5 volts, whereas the H.T. volt-

age is 90. A saving in parts is effected here by using a common screen-dropping resistor for the R.F., mixer, and I.F. tubes, with a single bypass condenser as well. The screens of these valves are tied together at the sockets, and are fed through a 10,000-ohm resistor, which is bypassed by a 0.05 μf. condenser.

All valves except the output stage are used with zero initial grid bias, thereby simplifying the grid circuits very much. The valve data sheets on the types used state that they may all be operated under these conditions, so that anyone who might feel that the valves would suffer need have no fears in this respect. It would be possible to effect some slight saving in H.T. current by biasing the first three valves in the circuit with a 1½-volt cell, but this would considerably reduce the sensitivity of the receiver, and would hardly be worth while. All three valves in the R.F. end of the circuit are controlled by A.V.C., and it has been found that even with an outside aerial, this does not result in appreciable signal distortion, as is sometimes encountered with small battery valves in areas where the signals from the local stations are very strong.

The R.F. end is quite conventional, except for the rod aerial, and nothing about its circuit requires special mention. The 1S5, or DAF91 acts as the second detector and first audio amplifier, but it will be noted that the amplifier section is triode-connected, and transformer-coupled to the output stage. This system is much simpler than any other for feeding the push-pull output stage, and in the long run is no more expensive than using an extra valve, and resistance-coupling. The main reason for using the transformer, however, is that doing so simplifies the filament circuit. It will be seen that the filaments are wired for 3 volts rather than 1½, and this has been done advisedly. The reason is that if 1½-volt filament operation is used, the current is exactly twice that for 3-volt operation. This might seem rather like a glimpse of the obvious, but it does have an important bearing on battery life. The current from the 3-volt filament battery is 200 ma., and with 1½-volt connection it would be 400 ma. If a very large A battery is to be used, the difference does not matter very much, but if the set is to be used as a portable, it will be desirable to use as small cells for the A battery as will give reasonable life. Now it is well known that dry batteries are not perfect. Indeed, it often happens that one cell will go down to a lower voltage than another that has had exactly the same amount of use. Because of this, it is always better, where possible, to use cells in series rather than in parallel. If the cells were perfect, there would be no difference between the two connections at all, but consider for a moment what happens when two cells are connected in parallel, and one tries to drop in voltage more quickly than the other. The one whose voltage tends to remain higher will then discharge through the other, poorer cell, until both are at the same voltage, so that if one cell deteriorates, it causes the other to deteriorate, too. When the cells are in series, the voltage of one cell drops, the voltage of the pair goes down by an equal amount, but no harm is done to the good cell. Even if one fails altogether, the other remains unaffected, and lives to be used once more. The result of this behaviour is that there is a definite tendency for two cells in series to give more output, in terms of ampere-hours than would the same two cells connected in parallel. This, then, is the reason why we have used the series connection for the filaments. When this is done, there is considerable virtue in having an even number of valves, for had seven been used, one of them would have been the odd man out, and would have required a resistor in series with its filament. It is bad practice to draw more current from one cell of a pair in series than from the other, so that with an odd number of valves, it is better to use the series resistor with one of them than to add an additional 50 ma. to the load on one cell, by connecting it to the junction of the two cells.

One more word about the grid bias arrangements. It is not strictly true to say that any of the valves in this set are run with zero bias. For example, when the negative end of the filament of a battery valve is earthed, and the grid leak is returned to earth, the positive end of the filament is at a potential of plus 1½ volts, and all other points on the filament are slightly positive with respect to earth. On the average, the filament is positive with respect to earth, to the extent of half the filament voltage, and in the case of 1½-volt valves, this is ¾ volt. The net result is that the valve's grid is biased negatively by ¾ volt. This is a form of cathode bias, since the filament acts as the heater and cathode of the valve at one and the same time. Thus, a filament-type valve can never really be said to work with zero bias. This, too, is the reason why the diode, in battery valves containing one, has its plate at the negative end of the filament. Only in this way can it be ensured that there is not a small but permanent negative bias on the diode plate.

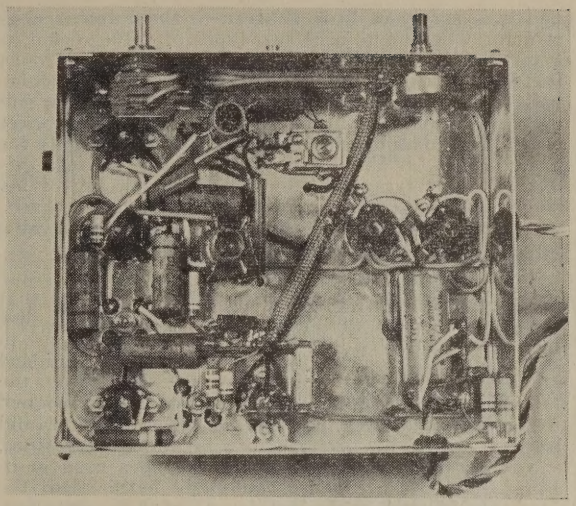
In this circuit, as in any other in which series filament connections are used, one of each pair of valves whose filaments are in series is automatically provided with a negative bias, provided its grid is returned to earth. The average filament potential of the upper valve in each pair is actually 2¼ volts positive with respect to earth, so that there is effectively a bias of this value applied to the grid of this valve. In our circuit, the R.F. amplifier is grouped with the oscillator-mixer valve, and has been put at the positive end of the pair. The grid return of the R.F. valve is through the A.V.C. line, and the detector diode load, to the filament of the detector valve. But this valve, too, is at the positive end of its pair (it is grouped with the I.F. amplifier), so that there is no additional bias applied to the R.F. tube's grid. This is just what is wanted to ensure that the sensitivity of the set shall be as great as possible, which is important in a battery set, whose valves are not capable of as high stage gains as can be obtained with A.C. valves.

The audio section of the set is uncommon these days, but was once quite a usual arrangement. The pentode output valves in push-pull are actually worked in Class AB_1. That is to say, compared with ordinary operation, they are over-biased, but that is all. They are not biased right to cut-off, or the operation would be called Class B, nor are their grids ever driven positive, which would enable them to qualify as Class AB_2. When this sort of output circuit was used in battery sets, it was usually called Quiescent Push-Pull, or Q.P.P., for short, and some of the older 2-volt battery pentodes were specially designed for this type of operation. For battery sets, Q.P.P. or Class AB_1, whichever you like to call it, has much to recommend it. It enables a considerable audio power output to be realized, at only a very light B current drain compared with what would be needed to produce the same output class Class A conditions. In the present case, for instance, the idling current

of the output stage is only slightly over 2 ma., whereas the same valves in Class A would draw almost 9½ ma. from the B battery for an output power of 0.36 watts. The AB_2 conditions used here give us a maximum of at least 0.5 watts for a battery current of only 2 to 3 milliamps at low volume levels rising to some 10 ma. at full output. It can be seen that Class AB_2 operation really pays dividends. If the same valves were used in Class B, with 150 volts on their plates, a maximum output of over 2 watts would be obtainable, but this would only be at the expense of further complication, in the shape of a driver stage which could deliver power to the grids of the output stage through a Class B step-down input transformer. Thus, unless very high output powers, of the order of a watt or more are required from a battery set, the Class AB_1 stage is well worth while. If, as here, it is driven by a transformer, phase inversion is no problem, while the necessary audio gain can easily be secured by triode-connecting the pentode section of the conventional 1S5 or DAF91, and using it to excite the transformer.

CHOICE OF VALVES

We have sometimes been criticized for offering in these pages circuits which employ a mixture of different types of valve, needing different sockets. Here, for example, we have used three valves from the Rimlock series, and three standard battery miniatures. Just why anyone should complain about this, we cannot quite understand. All the valves used in our circuit, as well as their sockets, are readily available,



Under-chassis view of the receiver. The front of the chassis is at the top of the picture. Note the shielded leads from the volume control to the detector, and the position of the coils.

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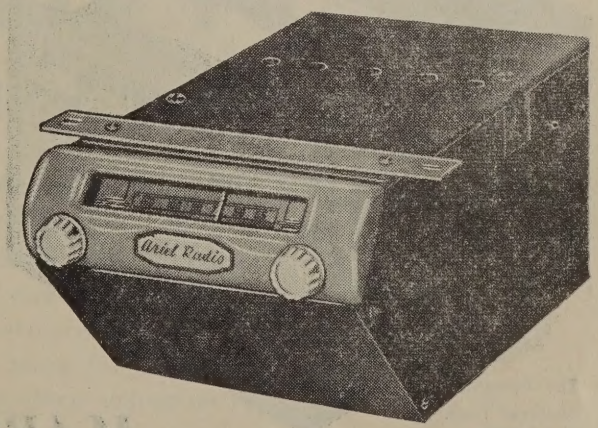

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and it is surely of little concern to the amateur constructor whether he uses two types of valve socket in a set, provided all the valves specified are good ones for their particular job. Today, when some particular valve is especially well suited to a particular job, one even finds manufacturers using a mixture of socket types. The manufacturer may have some grounds for grumbling a bit about this sort of thing, because different socket types all add to the complexity of his stock list, but in the case of the amateur, it must, we think, be largely prejudice against using valve types that are possibly unfamiliar to him.

The mixture of socket types in this set has come about simply because the three Rimlock valves that are specified are somewhat more convenient to use than the standard miniatures, for the positions in which they have been placed. There is no standard miniature equivalent for either the DK40 or the DL41, and while the set could have been designed to use all miniatures, it was considered that it would be just a little bit better, and a bit more interesting, too, with these relatively unknown types used in it. For instance, the DL41 is definitely better than the DL91 or its 3S4 equivalent for Class AB_2 operation, and the DK40 frequency changer is rather easier to use, especialy for the amateur builder, than the 1R5 or DK91, which have no separate oscillator plate. It also has a higher conversion conductance than the other two, and so will confer increased sensitivity on the whole set.

CONSTRUCTION

The construction of the set is very straight-forward, as can be seen from the photographs. It is built on a chassis 7 in. x 6 in., which enables the parts to be nicely spaced, without crowding, and without calling for unnecessarily long leads in the R.F. section. The dial and three-gang condenser are a unit which is sold especially for small receivers, and in particular for car radios. The condenser used in these units has a built-in planetary reduction drive, so that the advantages of gearing down from the knob to the condenser shaft is obtained without the use of a great deal of room for the more usual cord-drive system, which uses a drum for obtaining the reduction. The whole gang-cum-dial unit mounts simply on top of the chassis with two self-tapping screws through the dial portion, and a small bracket attached to the back of the gang condenser.

The aerial rod is mounted on two pieces of insulating tag strip with two right-angle tags to enable the strips to be fixed to the top of the dial. The rod itself is fixed to the insulating strips by tying it with a piece of thin cord, passed through the holes in the tag strip. If wire is used to tie the rod to the strips, care must be taken to ensure that the wire does not form a short-circuited turn round the rod. If this is done, the inductance of the winding on the rod will be all wrong, with the result that the aerial

(Continued on Page 41.)

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The Application of Selective Calling to Party Line Radio-Telephone Circuits

By R. MOTION and C. H. STURTON (N.Z.P.O.)

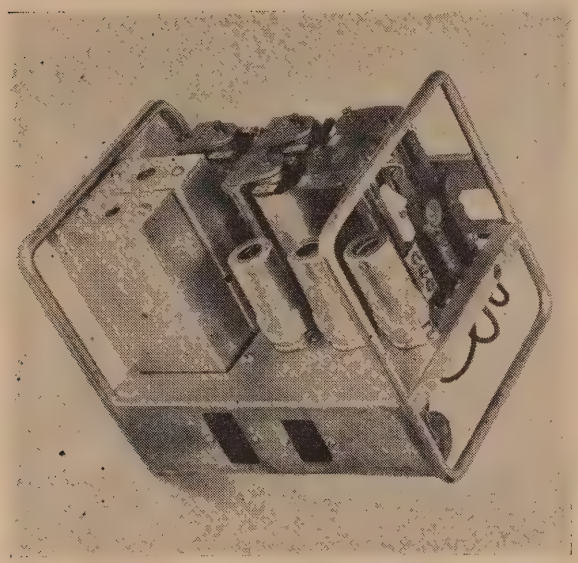


Fig. 6.—Pictorial view of decoder unit.

SUMMARY

This article describes a system of calling individual subscribers on a party line radio-telephone circuit. The equipment involved has been developed in the New Zealand Post Office and is at present being tested. It provides for the selection of an individual subscriber to a radio telephone service and for the connection of that subscriber to the national telephone network, or to any other subscriber in the radio system.

The system evolved could be applied to a fixed radio-telephone service for isolated localities or to a mobile radio-telephone service for motor-vehicles, ships, etc.

INTRODUCTION

The need for a telephone service capable of communicating with mobile stations has been recognized for a number of years now, and overseas organizations have developed a variety of means of carrying out this function. Some success, for instance, has been gained in communicating by induction currents on railroad services and consideration has been given to carrier frequency calling systems operating by induction from overhead wires. However, the method which has gained the greatest favour has been the application of radio telephony, particularly V.H.F. radio telephony, to the problem.

The radio equipped taxi, police car, or fire brigade is now a common sight and the expansion of these services has meant a heavy call on the limited range of radio frequencies available for this purpose. The systems at present in use in New Zealand are limited to communication within their own particular network, but there is a considerable potential field in the extension of the regular telephone network to include ships, vehicles, remote communities with no line communication, etc., and it is to satisfy this demand that the system considered in this article is being developed.

The extension of the telephone service to include radio-equipped units poses a number of problems among which are the following:—

The radio equipment in the mobile station should use "duplex" working as opposed to the "press to talk" single frequency simplex system at present in common use in New Zealand, in order that conversation will be carried on in exactly the same manner as over a land line telephone. This means that transmission and reception must be carried out on separate radio frequencies to avoid interference between the transmitter and adjacent receiver. Some system of sharing a radio channel is necessary as not only would the cost of the service be prohibitive if a separate channel was allocated to each subscriber, but also the available supply of channels would be quickly used up and only a very limited number of radio-telephone subscribers could be served.

Party line telephone systems have been in use ever since the telephone came into commercial use and it seems logical to extend the radio-telephone service along these lines in order to conserve channels and reduce rental costs. The modern party line telephone uses selective calling of the individual subscribers, thus ensuring the reception of the call by the required party only and the application of this principle to the radio-telephone system is considered to be highly desirable.

Other problems are the design and construction of suitable equipment to interconnect the telephone network and the radio-telephone subscriber with the minimum of delay and the maximum of efficiency, the prevention of false calls due to radio frequency noise pick-up, and the design of a system which will receive the wanted call even under conditions of adverse signal-to-noise ratio.

SYSTEM SPECIFICATION

It is considered that the radio-telephone service finally accepted should be capable of fulfilling the following function.

(a) It should be able to select and call any one of a number of subscribers (40 or more) on one radio channel without causing false calls to any other subscribers on the same or other channels, and to do so under conditions of high signal level, rapidly fading signal or adverse signal-to-noise ratio.

(b) It should provide a visual "busy" indication to all other subscribers on a channel when the channel is in use by any one subscriber.

(c) The mobile section of the signalling equipment should be simple, compact, and robust, in order that it may stand rough usage, and may fit into the cramped spaces available on cars, trucks, etc.

(d) The mobile signalling equipment should be capable of attachment simply and easily to existing commercial mobile radio equipment and should

operate with the very minimum of power consumption.

(e) The equipment should be so designed that it may be produced in New Zealand or overseas from readily available material and by standard techniques in order that the capital cost may be kept low. This especially applies to the mobile units, as many are involved.

(f) The exchange equipment should be such that calls to the radio-telephone subscribers may be handled via the usual telephone "special services" network (i.e., via the "toll" board or "rural" system in use at present by the Post Office).

SYSTEM DESIGN

The provision of selective calling on radio systems has been carried out overseas in a number of different ways and various commercial organizations have developed and installed systems. In general, these systems may be broadly classified into those which use "impulsive" calling and those which use simultaneous or sequential tone calling.

The "impulsive" calling system uses an interrupted tone modulation of the transmitter to pulse a "stepping" switch or other device at the receiving end and to call the subscriber by a pre-arranged pulse code. Due to the presence of rapid flutter fading on V.H.F. mobile channels when received close to hills and other sources of reflection there is a strong possibility of false calls being caused by impulses being missed or extra impulses added to the received code. For this reason this system has not been considered desirable in a hilly country such as New Zealand.

The steady tone calling system uses a combination of different audio frequency tones to operate an alarm through selective filters in the receiver and call the wanted subscriber. Whether the tones are sent one after the other or altogether is of little account though the "sequential" system reduces intermodulation products in the receiver output, while the "simultaneous" system (i.e., all required calling tones sent at once) has the advantage of a shorter calling time, and thus less non-operational channel time.

In the system under development, the simultaneous tone transmission method is used and the possible generation of false calls by intermodulation products or harmonics is removed by restricting the range of calling tones to within one octave.

The normal telephone calling system uses 10 digits for dialling and to fit in with this system it is proposed to use 10 separate calling tones spaced within the range 1,800 to 3,500 c.p.s., the actual values tentatively selected being as follows:—

1	1,800	6	2,610
2	1,940	7	2,810
3	2,090	8	3,025
4	2,250	9	3,255
5	2,420	10	3,500

These frequencies are separated by a constant percentage in order that the filters used in the receiver may all have the same relative bandwidth (i.e., the same Q) thus standardizing on the filter type and design.

The use of any two of these frequencies at once allows the calling of up to 45 individual subscribers on one radio channel, while three or more tones allows of 100 or more subscribers per channel.

The present prototype design is based on the transmission of two tones at once and provides for selection

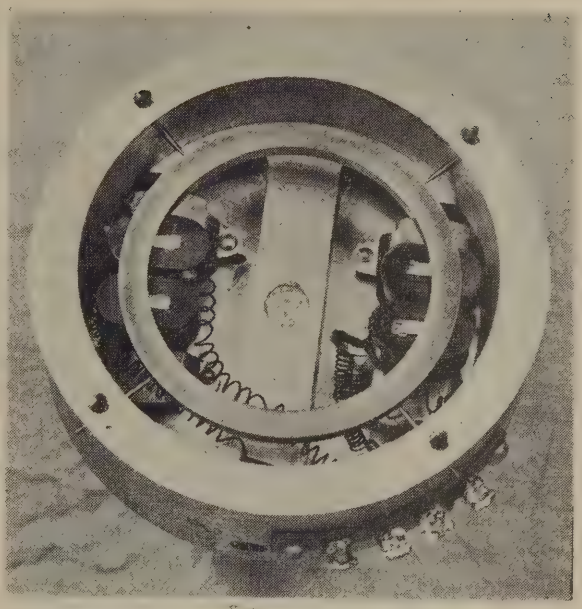


Fig. 1.—Pictorial view of "ring" assembly.

of any one of 45 subscribers on a channel. The exchange equipment (described in detail later) uses two selector switches operated by a standard telephone dial to select the required tones then transmit them for a timed period of five seconds which period is sufficient to operate the relay in the called mobile unit and ring the bell.

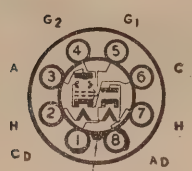
The mobile unit design is important as the operational requirements are difficult. The selective reception of a tone may be carried out by means of tuned relays, reed relays, or resonant circuit filters though in this case the tuned relay is rejected due to the difficulty in obtaining a high enough Q. Reed relays have been used overseas apparently with considerable success, but their design and manufacture to give satisfactory operation over a wide range of temperature variation and mechanical vibration is a difficult problem. The prototype design at present under test has resonant L.C. circuits as selective elements using high Q "Ferroxcube" cored inductances, temperature compensated with negative temperature coefficient condensers. This type of circuit has proved very reliable under test with temperature cycling, vibration, and shock, while it makes for a simple design of mobile unit using standard electronic components.

The reception of false calls is guarded against by a "differential" arrangement of the valve operating the call relay and by time delay circuits in the unit such that the applied tones must be of the right frequencies and be received for an aggregate of three seconds before the bell is operated. Tests to date on the bench and in the field have shown the system to be very free of trouble from false calls due to noise or any other cause.

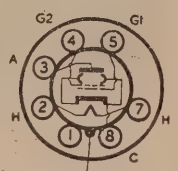
The system as developed is versatile in that it fits in with existing practice both in the mobile units and the telephone exchange unit. It is trouble free operationally and its design does not preclude the use of other types of selective devices or of circuitry in the mobile units, provided that the required degree of stability and selectivity is maintained.

Short of a 70L7GT? - then *BRIMARIZE!

—change to a BRIMAR 35L6GT. This valve is similar in characteristics to the 70L7GT and both are Octal types so that the necessary alterations are straightforward. The principal change is the substitution of a metal rectifier for the rectifier section of the 70L7GT. Wherever possible this rectifier should be mounted horizontally in order to ensure adequate cooling, and it is advisable to check the total rectified current. If it is above 40 mA a series resistance should be inserted in the smoothing circuit.



TYPE 70L7GT
LOCATING KEY



TYPE 35L6GT
LOCATING KEY

RATED CHARACTERISTICS	35L6GT	70L7GT
Heater Volts	35v.	70v.
Heater Current	0.15A.	0.15A.
Anode Volts	110v.	110v.
Anode Current	40mA.	40mA.
Screen Volts	110v.	110v.
Grid Bias	— 7.5v.	— 7.5v.
Output	1.5w.	1.7w

CHANGE SOCKET			CHANGE CONNECTIONS		OTHER WORK NECESSARY
TYPE	FROM	TO	From Old Socket	From New Socket	
35L6GT	INT/OCTAL NO CHANGE		Pin 1	+ VE RECT	Increase line cord resistance by 175 ohms. SenTerCel miniature rectifier TYPE RM1 may be fitted to chassis or cabinet.
			Pin 2	Pin 2	
			Pin 3	Pin 3	
			Pin 4	Pin 4	
			Pin 5	Pin 5	
			Pin 6	Pin 8	
			Pin 7	Pin 7	
			Pin 8	— VE RECT	

NOTE that in the case of the 70L7GT the cathode of the tetrode section is connected to Pin 6 instead of the more usual Pin 8 and that, owing to the lower heater voltage of the 35L6GT an alteration in line cord resistance is essential.

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The following paragraphs give technical details of the system as developed:—

GENERATION OF SIGNALLING TONES

The first requirement in a system of selective calling of this nature is the generation of the signalling tones. The Q of the tuned circuits used in the mobile equipment requires to be at least 100 in order to prevent the pick-up of unwanted adjacent tones and therefore the response to the calling frequency will be 0.7 of maximum at points 0.5 per cent. off resonance. Since the greatest amount of any frequency drift which may occur will be in the mobile selective circuits, it is desirable that the calling tones should maintain their allotted frequency within 0.05 per cent. and that they should maintain this tolerance year in and year out without requiring correction at any time. These tone generators must operate, therefore, as primary standards of frequency for the system, since even a laboratory measurement of audio frequencies to an accuracy of 0.01 per cent. is a difficult undertaking and consequently such measurements in the field are most undesirable.

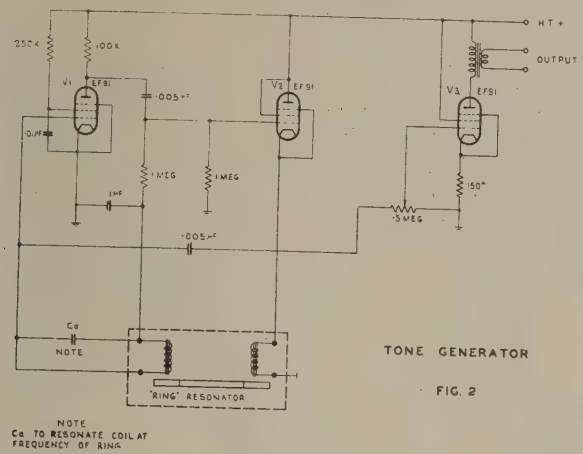

Fig. 2.—Tone generator schematic.

The use of L.C. or R.C. tone generators was considered but rejected as there remains always some doubt as to their long-term stability and motor-driven tone generators have a doubtful short-term stability within this tolerance.

This leaves systems of tone generation based on mechanical resonance (flexural mode vibrators) of which the tuning fork is an example as is also a recent development of the quartz crystal oscillator.

Quartz crystals would have been an ideal solution but were not readily available in the range of frequencies required, so recourse was made to an annular ring vibrator because this shape is easy to produce by normal production methods. The ring, constructed of steel, is excited in a flexural mode of vibration having four nodal points around the circumference, coupling being made to the maintaining amplifier via electromagnetic coils, wound on magnetic cores arranged on opposite sides of the diameter (see Fig. 1). The mounting system is an aluminium alloy casting, the ring being supported on the points of steel needles situated at the nodes.

To keep the frequency of vibration independent of temperature fluctuations, the ten rings are mounted in a temperature controlled oven. However, in future designs it is hoped to use a low temperature coefficient alloy, such as elinvar, for the rings and do away with the oven.

The maintaining amplifier schematic is shown in Fig. 2, the valve V_1 operating as an amplifier feeding a cathode follower, V_2, which couples energy to the low impedance coil of the ring. Automatic amplitude control is obtained by using V_2 also as a rectifier and feeding back the resultant D.C. to the grid of V_1 to control the overall gain, and thus limit the amplitude of oscillation. Valve V_3 is an output amplifier to give an output to line of up to 10 mW as required.

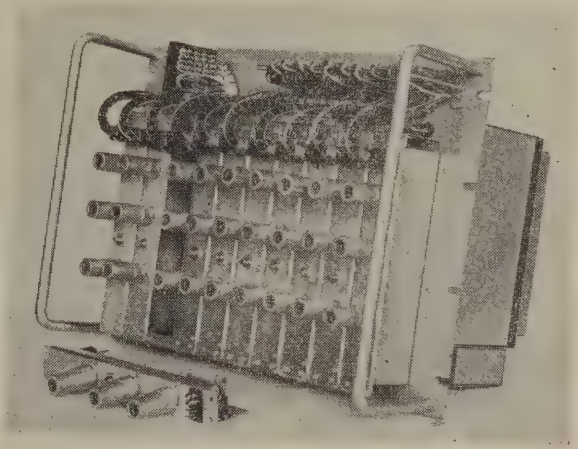

Fig. 3.—Pictorial view of tone generator assembly.

The tone frequency obtained is well within the required tolerance with variation in H.T. or L.T. supplies up to ±20 per cent., and is of good sinewave form. Also, since the frequency of oscillation is dependent only on the physical dimensions of the ring and on the modulus of elasticity of the steel used, the rate of ageing is very small and well within the required tolerance. The complete assembly of the tone oscillators is shown in Fig. 3.

The outputs of the two-tone oscillators selected for a call are combined in the tone mixing amplifier (see Fig. 4). This amplifier presents a high impedance to the individual tones and reduces the interaction between individual oscillator outputs. Thus a number of exchange units may be fed from a common tone generator assembly in the telephone exchange.

TELEPHONE EXCHANGE UNIT

This unit, the schematic of which is reproduced in Fig. 4, is used to connect the telephone system to the required radio telephone subscribers via the toll board or manual telephone board depending on the locality.

The toll operator, on the receipt of a normal incoming call from the telephone subscriber, answers the call in the usual manner, then plugs into the "call" jack of the telephone exchange unit associated with the wanted radio telephone subscriber, thus setting up this unit to accept the dialling impulses. The operator then dials the required number and uniselectors A and B are stepped around to positions corresponding with the number

(Continued on Page 48.)

An Englishman Looks at Television

By J. H. A. WHITEHOUSE

No. 1: TELEVISION AND THE MAN IN THE STREET

As an English newcomer to New Zealand, who has spent many years in radio, and who saw television broadcatsing born, techncially, commercially, and from the point of view of the man in the street, it is not unnatural that, with the growing interest in television in this country, a great many questions should have been asked me. Perhaps these few notes may serve to give one man's impression of the impact of television on the public at large. Television has an impact, make no doubt about that!

However, contrary to what many people thought, it has not knocked out sound broadcasting. True enough, TV is fascinating, but at Home, we have found that each, television and sound broadcasting, has its own quite distinct and separate contributions to make.

Each does some things better than the other can ever do. I do not think that my friends at the B.B.C. would complain if I were to say that on many occasions when a crack "personality" radio show has been tried on television, it has proved a "flop." With certain kinds of programme there is a curiosity value the first time, but after that, in spite of trick camera work, they are just plain boring. Sound can do so much, just by clever script writing and "effects," that television can never do.

When people first get their TV set, they are inclined to sit glued to it like a chicken to a chalk line, but they soon find out that their mania for seeing everything that is on the picture programme is just as unsatisfactory as assuming that everything on "sound" must be listened to. The result of this is that, in view of the fact that today, darkened rooms are no longer necessary for viewing TV, people potter about, or sew, with one eye cocked occasionally on the screen (and with the sound part of the TV turned off) listening to their chosen sound programme until the picture they want to see comes up. Crazy people, like the writer, go so far as to have a timed tape recorder which, if two good picture and sound programmes clash, switches itself on and records the sound programme for later use. What has happened is this; so far from sound being relegated to background music for the housewife, more radios are being bought and replaced, but with far greater emphasis on better quality of reproduction. This is reflected by the number of radios which, since TV started, have deteriorated with age, and have come into the dealers' shops for service, or have been replaced by better sets.

Since arriving here, I have heard a great deal of talk about the cost of TV programmes. The B.B.C., it is true, have gone to a great deal of expense to perfect big dramatic and similar types of show, yet if one is to judge by the density of telephone calls at any particular time, these are not the TV programmes which give the telephone operators time to knit! It is reality stuff—great occasions, intimate shots of famous persons, and sport that really "stop the clock." These do not rely on expensive casts and scenery. They rely on a slick mobile team of camera operators, or on very simple and often (when actually seen in the studio) ridiculously small sets. The camera does the rest. One of the best, if not the crack TV item is the "Television News Reel." It is as difficult to tell, today, whether one is looking at a film or a "live" show, as it is to detect a recorded sound programme, and that goes for full-length features as well.

Another TV show which is very cheap to produce and which is very successful, is the children's hour, to which many people restrict their children's viewing. The programme is not only perfectly keyed to child humour, but is a shining example of the television screen as a blackboard for teaching everything from needlework to conjuring tricks. This programme brought into being two famous characters who are probably the best-known television personalities to both children and adults alike, "Muffin the Mule" and "Mr. Turnip." Both are puppets, both act with human actors, and their ridiculous adventures and antics have long since made us forget that they are only dolls.

As far as the effect of TV on children is concerned (quoting my own as an example) it tremendously widens their interests, and certainly has not affected such things as homework. The B.B.C. are very careful not to put over shows which are "horrific." If a play, for instance, does contain such an element, an announcement is made beforehand. This is always done, too, if a snake is going to be shown at all, as, for example in the very popular "Animals from the Zoo" series. Incidentaly, as far as I know, this costs nothing to put on except for transport, and perhaps a fee for the lecturer.

It may come as a surprise to many that a twelve-inch diagonal picture tube is perfectly adequate to entertain a dozen or more in comfort. There has been a tendency to go up in size to 14 in. and 17 in. tubes, but the 12 in. tube is the popular size. Flatness of picture is being increasingly appreciated. The Philips organization led the way in that with their amazing little projection tube, which costs so little to replace, and which puts up brilliant flat pictures.

Many sporting organizations feared that TV would affect their takings. What actually happened was that there are more boxing, racing, football, and other sporting fans than ever before, and they are going to watch for themselves what they learned to enjoy on television. The effect on the cinema is, in general, to make the TV owner more "choosey." Rather than visit a cinema weekly or bi-weekly, he selects (often from the excellent TV film reviews) the films he wants to see, and then goes and sees them.

Television has, of course, presented special problems to the radio industry and to the dealers, but from what I have seen of the very high standard of knowledge in the electronic arts in New Zealand, the industry here will tackle these problems, when television arrives, as effectively as did their English confreres. But that is another story.

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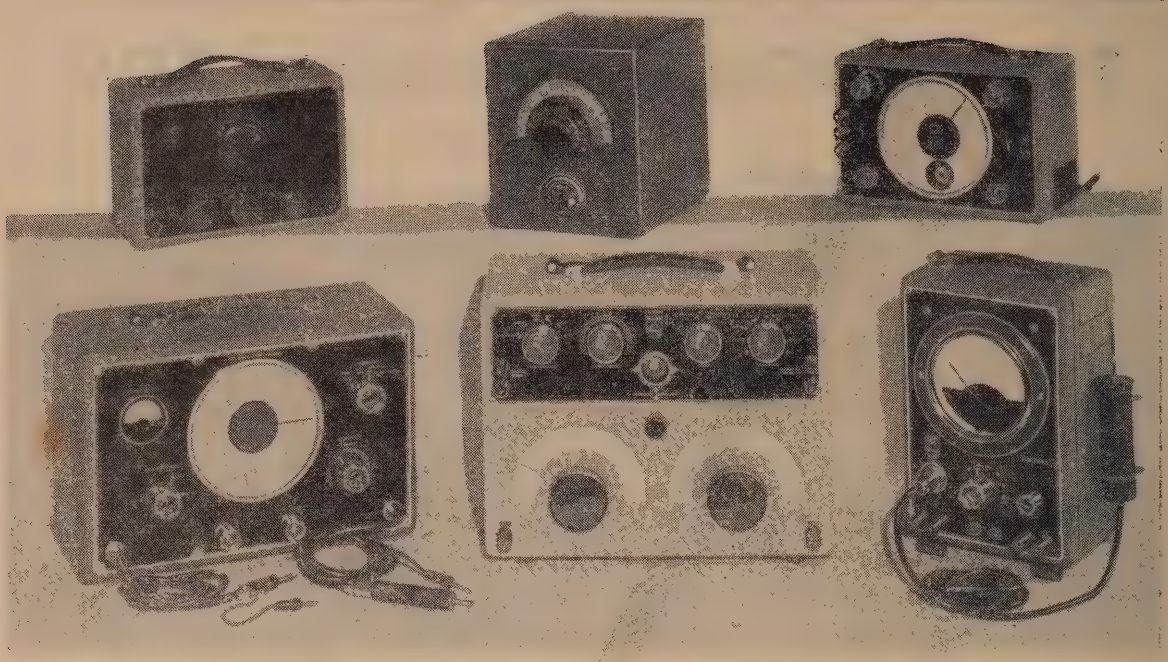

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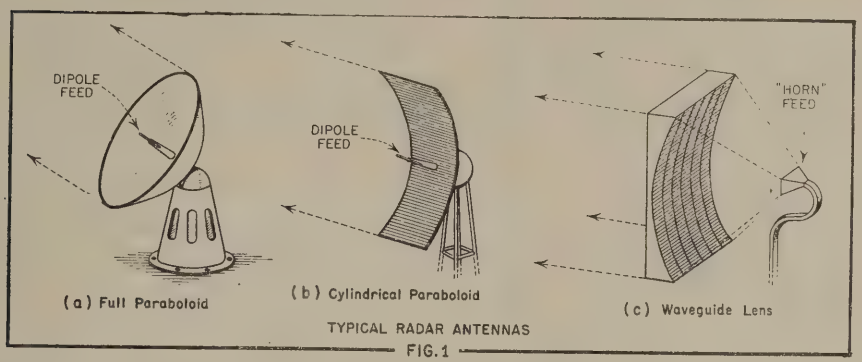
PM4

Introduction to Radar Techniques

Part V.—The Antenna and Duplexing System

By the Engineering Department, Aerovox Corporation



TYPICAL RADAR ANTENNAS

FIG. 1

This is the concluding article in the series dealing with the fundamentals of the basic radar system. It is concerned with the radar antenna system and the electronic switching means employed to enable the same antenna and transmission line to be shared between the radar transmitter and receiver. "Duplexing," as this function is called, is common only to radar practice and has its only counterpart in the "antenna changeover" switch of communications radio. The other specialized components of the typical radar system were discussed in earlier articles.

Because of the very short wavelengths used in modern radar (about 1 to 25 centimetres), the antennas employed are capable of very high gains. This high gain is a useful by-product of the high directivity required to obtain accuracy in determining the position of a radar target. In order that the azimuth and elevation of a target be indicated with precision, the width of the antenna pattern must be small. Therefore, if the total energy radiated by the antenna is concentrated in a narrow cone, the radiated signal strength on the axis of that cone will be hundreds of times greater at a given point in space than if an omni-directional antenna were used.

The gain of a highly directional antenna, such as the paraboloid, as a function of its aperture area in square wavelengths, is given by:

$$(1) \qquad G = \frac{8A}{\lambda^2}$$

Where:

G is the power gain of the antenna
A is the antenna aperture (cm^2).
λ is the operating wavelength (cm)

From this it may be seen that the gain for a given area is inversely proportional to the operating wavelength *squared*. Thus, an antenna of a given area will have 100 times more gain at 1 centimetre than it has at 10 centimetres. For this reason, antenna gain is relied upon to compensate for the lower R.F. powers available at the shorter wavelengths used for modern radar.

Fig. 1 depicts several forms of basic microwave antennas commonly employed for radio detection and ranging. Of these, the paraboloid (Fig. 1A) has been used the most extensively to date. In this design, a parabolic reflector made of sheet metal, perforated metal, or screen, is *illuminated* uniformly over its surface by R.F. energy radiated from a source at the focal point. This source, usually called a "feed," may be a small dipole or a waveguide horn. The divergent radiation from this source is focused by reflection from the parabolic surface into a nearly parallel ray like that of a searchlight. See Fig. 2. Beamwidths as narrow as ½ degree at the half power points are produced in this manner. The theoretical beamwidth is related to the wavelength and diameter of the parabola as:

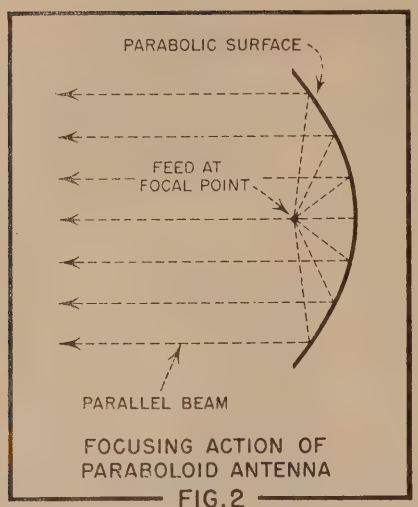
$$(2) \qquad \theta = 70\frac{\lambda}{D}$$

Where:

θ is the half-power beamwidth in degrees.
λ is the operating wavelength (cms)
D is the diameter of the parabola (cms).

In some applications, it is necessary to produce a radar antenna having a radiation pattern which is narrow in elevation but wide in azimuth, or vice versa. This is usually accomplished by the use of a *cylindrical* parabola, or a "cut" parabola, as shown in Fig. 1B. Unlike the complete paraboloid, this antenna is highly directional in one plane only, i.e., the plane of its greater aperture dimension. By "shaping," or using various sections of a full paraboloid, the pattern in both the vertical and horizontal planes can be controlled to fit any given application. Equation 2 may be used to predict the approximate beamwidth in either plane by using the diameter of the parabola in that plane.

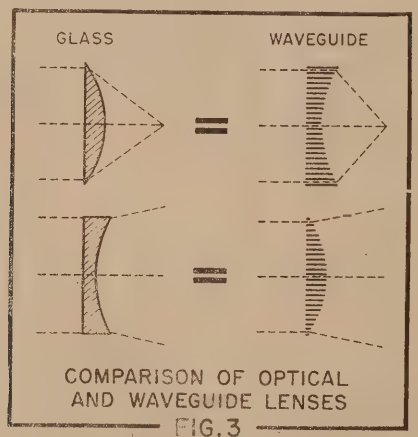
A third general type of antenna, which is finding increasing microwave radar application, as well as widespread use in microwave radio relay systems, is the *waveguide lens* type illustrated in Fig. 1C. This design makes use of the fact that a mosaic of waveguides of different lengths can act as a lens to focus radio waves in a manner similar to the focusing of light waves by a glass optical lens. This comes about because the radio frequency waves travel at a different velocity through



FOCUSING ACTION OF PARABOLOID ANTENNA

FIG.2

the waveguides than they do in free space, just as light travels at a different velocity in the glass lens. As a result, rays which enter one end of the waveguide mosaic lens may be converged, diverged, or rendered nearly parallel, as with an optical lens. An important difference, however, is that the contours for waveguide lenses are opposite those of the glass lenses which perform the corresponding functions, as shown in Fig. 3.



COMPARISON OF OPTICAL AND WAVEGUIDE LENSES

FIG.3

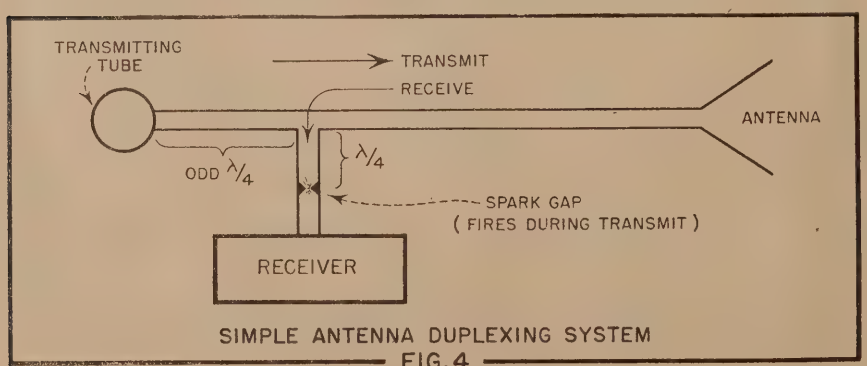
This reversal is due to the fact that radio waves travel *faster* in the metallic guide than in air, whereas light waves travel *slower* in glass than in air. Hence, the wave fronts are refracted differently by the same contour.

The same kind of "feed" systems may be employed to illuminate lens antennas as are used for parabolas. The lens antenna has several advantages over the parabola, including less wind resistance for a given aperture and the fact that the feed point is behind the antenna, rather than in front of it. This places fewer restrictions on the feed system to prevent distortion of the radiation pattern. The gain and half-power pattern widths of a metal lens antenna are the same as those of a parabola of equal dimensions, as given by Equations (1) and (2).

THE DUPLEXING SYSTEM

Even with the most powerful transmitters and the most sensitive receivers available, the successful operation of a radar set requires the highest antenna gain and directivity possible. Since this, in turn, means antennas having large physical dimensions, it is highly desirable to use the same antenna for both transmitting and receiving. In this way the gain of a single large antenna is utilized twice. To do this, however, it is necessary to connect the antenna to the transmitter for a few *millionths* of a second while the pulse is sent out, and then switch it to the receiver during the "listening period" between pulses. This function is called "duplexing" and is accomplished by gas filled devices known as "Transmit-Receive" tubes, or more simply, "T-R" tubes. The duplexing system must prevent the very high peak power of the transmitter from damaging the sensitive crystal mixer input stage of the receiver while at the same time "recovering" fast enough after each pulse to enable the receiver to receive echoes from nearby targets. The duplexing system must also make provisions to prevent the weak received signals from being absorbed in the magnetron transmitting tube.

To fulfil these requirements, modern duplexing systems make use of the large power difference between the transmitted signal and the received echoes. Since the transmitter power is of the order of *kilowatts* or *megawatts*, while the received signal from distant targets is more typically measured in *micro-microwatts*, a switching device which will discriminate between such extremes of power is used. Fig. 4 illustrates an elementary duplexer utilizing this principle. Here a spark gap is placed across the branch line leading to the receiver and set to break down at high power but remain inoperative at low power. Since the discharge in the gap constitutes a virtual short circuit across the transmission line, very little transmitter power reaches the receiver. If the distance from the junction point to the gap is one-quarter wave-length, the impedance of the branch line appears very high when the gap is "fired" and all of the power goes through to the antenna. When the transmitter pulse ends, the gap is extinguished and, since any received signal is much too weak to initiate a breakdown in the spark gap, signals flow freely to the receiver. If the length of transmission line between the



SIMPLE ANTENNA DUPLEXING SYSTEM

FIG.4

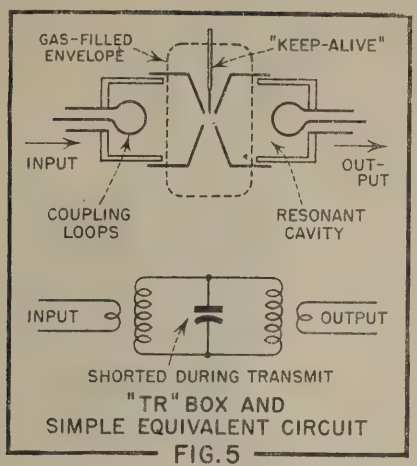


FIG.5

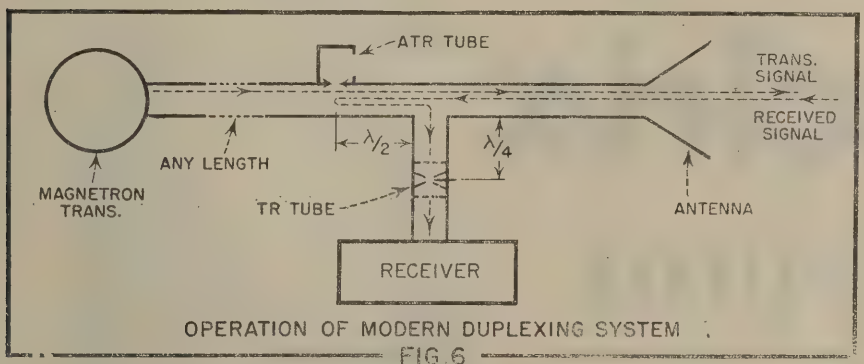


FIG.6

receiver arm and the magnetron is properly chosen, the received signals will encounter a high impedance in travelling toward the magnetron and hence will flow mainly into the receiver.

In actual practice, the simple duplexing system of Fig. 4 is employed only with refinements. To obtain adequate crystal protection, the voltage at which the gap fires must be reduced. This is done in T-R tubes by enclosing the spark gap in an envelope which is filled with a gas, such as hydrogen, under pressure. A third electrode, known as a "keep-alive", is also introduced into the hollow cone forming half of the gap. The function of the keep-alive electrode, which is maintained at a high D.C. voltage with respect to the cone, is to produce a small gas discharge within the cone. The presence of this keep-alive discharge greatly reduces the time required for the main gap to fire when the R.F. pulse arrives. A third refinement consists of making the gap part of a tuned circuit which is resonant at the transmitter frequency. This increases the voltage across the gap and further reduces the time required for the tube to fire.

Fig. 5 shows a typical T-R tube in its resonant cavity and a simple lumped-constant equivalent circuit. The T-R box acts as a band pass filter when the gap is not ionized during receiving, and the signal is attenuated only about 1 db. in passing from one coupling loop to the other. When high power ionizes the gas, however, the band-pass properties of the cavity resonator are destroyed since the effect is the same as short circuiting the capacitance in the equivalent circuit. Under these conditions the attenuation is about 60 db. and very little power is coupled from one loop to the other. The important properties of the T-R switch are the *ionization time,* the *leakage power* which reaches the receiver through the fired device, and the *recovery time* necessary to allow the gas to deionize so that signals can reach the receiver. These properties are controlled by varying the T-R gas filling and water vapour content, the cavity "Q," the keep-alive voltage, etc.

As was mentioned above, provision must be made in a duplexing system to ensure that a large portion of the received signal is not lost in the transmitting tube which terminates the line from the antenna. In early duplexing systems, use was made of the fact that the non-oscillating magnetron tube does not match the line impedance very closely, so that most of the power is reflected. The T-R junction was then placed at a point on the transmission line where the impedance toward the magnetron was high. This system worked but placed undue restrictions on the position of the T-R junction and the "cold" impedance of the magnetron. It has been replaced in most cases by the use of a device known as an "anti T-R" tube," or an "ATR."

Fig. 6 depicts a duplexing system using an ATR tube in conjunction with a T-R tube for effective antenna switching. The ATR tube is a resonant, gas-filled device constructed in a manner similar to that of the T-R tube, but with only one coupling loop or iris. It is placed on the transmission line between the magnetron and the T-R in such a manner that it has no effect on the passage of the transmitted signal when it is ionized, but constitutes a high series impedance to the received signal in the unfired condition. The line length between the T-R and the ATR is then chosen so that the received signal "sees" a high impedance toward the magnetron regardless of the cold impedance of the latter.

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Of Meters and Music

By V. M. Stagpoole

About the time that the average sound enthusiast graduates from a 6V6 and a crystal pick-up to something slightly more ambitious, he becomes afflicted by a dread disease which might be called "meteritis." He loses faith in his ears, and needs a meter to tell him whether the reproduction is good or not. If the matter rested there if wouldn't matter much, but this affliction also attacks people who should know better. Audio engineers are among the first to bow their proud heads before the twin altars of the distortion meter and the audio oscillator.

These people are always ready and willing to run their meters over some audio set up, assert that it has "high fidelity" and then sit and listen to the results with smiles of sheer joy on their faces, while those with any feeling for good reproduction are driven slowly mad.

These savants, having been assured by their meters that all is well, turn off their ears and listen with their eyes. Surely the primary purpose behind music is to produce aural enjoyment—not visual delight!

I'm afraid I'm one of those who holds the nowadays heterodox view that the human brain, after millions of years of development, is a better distortion meter than anything produced in a laboratory in the last 30 years.

Surely the primary purpose behind reproduction of music is to provide pleasure—not assault the ear with a cacaphony which would make any normal person reach for the tone control.

This dependance on meters has led to the peculiar doctrine that the "public doesn't like high fidelity." This should be stated "the public doesn't like what the engineers call high fidelity." This is dead right —they don't. And neither does any person who really uses his ears.

The fact is, that despite all tests to the contrary, neither the public nor the engineers have ever heard "high fidelity." I could go on giving examples of radio engineers being led up the garden path by their meters, till the cows come home, but one example will be enough to show what I mean.

CASE 1 "METERITIS"

The Ribbon Microphone

Round about 1930 (more or less) the engineering brains came up with the microphone to end all microphones—this was the original ribbon velocity microphone.

One of the writers said at the time, "This opens new possibilities for high fidelity sound pictures and broadcasting." Now all this was not stated after a series of practical tests (they had occurred of course) but merely on the strength of a measured flat frequency curve.

I don't think I'm giving away secrets when I say that, given the opportunity, the velocity microphone can give very "woolly" results. In fact, for close work on a larger bass cut (about 20 db. at 50 cycles) has to be introduced to ensure intelligibility.

Somehow I can't reconcile the term "high fidelity" with a fudged up response curve.

The writer recently had the opportunity of attending some tests carried out with ribbon microphones and it was apparent to most present that although response was in general very good something was lacking in the reproduction as compared with the original.

Amongst other things lacking from the output of a ribbon mike are transients. As compared with the new miniature condenser microphone, the only one capable of satisfactory transient response, the ribbon microphone may be 10 to 15 db. down! Yet for 20 years engineers have been swearing that the ribbon mike is perfect because it has got a flat frequency response.

CASE 2: "CIRCUITITIS"

The Flewelling Audio System

About three years ago a radio engineer in the United States, Edmund Flewelling, anonunced a new sound system, which, he said, gave substantially improved reproduction over systems currently in use. The engineers took one look at his plans and specifications and condemned it outright. It didn't have enough feedback, it had a hole in its response curve, it used electrolytic condensers in the crossover network, therefore it couldn't be high fidelity. No one ever said it was, least of all Mr. Flewelling, who, not in the least discouraged, took his gear along to the Audio Fair in New York and proceeded to demonstrate. It stopped the show. Visitors sat around and listened amazed. Hundreds of people—musicians, engineers, and laymen—said it was the nearest approach to true sound they had ever heard. Yet this system has dropped into obscurity because the big boys of radio have stated that it can't be "high fidelity." The basis of the F.A.S. was a new method of loading the low frequency speaker, a device which has become known as an "air coupler."

Audio enthusiasts who have used this system would as soon go back to the conventional bass reflex cabinet as they would to the magnetic armature speaker. This system should have been hailed with shouts of delight by those who talk about "high fidelity" instead it has been simply passed over.

Well, these two examples should be enough to show the futility of relying on meters or circuit diagrams. The time has come for a new approach to sound reproduction. Response curves, distortion, measurements, intermodulation testing—all have their uses, but let's not forget that the listener has the last say. The final criterion is the human ear, trained by listening to actual performances by orchestras or singers, and then listening critically to sound as it is reproduced. The approach, in fact, of the "educated ear."

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DIAL REPAIR

Now, whereas the title of this article might at first glance be considered to refer to mud-packs, face-lifts, eyebrow plucking, etc., in an attempt to remove the ravages of the previous night's gin party, in actual fact it is intended to show how an unpleasant, but all too frequent, job in radio servicing can be done.

Although the old Crowe type friction drive dial went out of date years ago in favour of more resplendent edge-lit slide-rule type dials, the radio serviceman nevertheless continues to get plenty of these old-timers in for service.

The complaint is nearly always the same—the drive is slipping and will not rotate the gang. This slipping is almost invariably brought about by the groove in the tuning shaft wearing to such an extent that it touches on the bottom of the drum, thereby losing its friction (Fig. 1) upon which it relies to turn the dial.

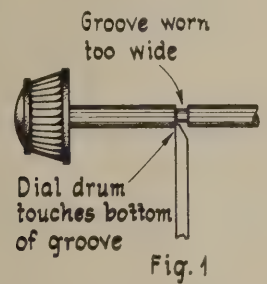

Fig. 1

This slip generally occurs near to the tuning point of the listener's favourite station where a certain amount of wear on the drum friction edge plus the wear in the tuning shaft groove add up to start the trouble. The wear on the friction edge of the drum unless extremely bad need not cause any undue concern since the spring loading of the tuning shaft will take up any eccentricities here. The worn groove in the tuning shaft, however, must be attended to and it is emphasized here that a satisfactory job can only be made by dismantling the dial completely. Any attempt to fix it in its assembled condition generally ends in disaster.

The spring clip holding the pointer in place should be removed and the pointer swung out of the way of the centre bush. The drum pivot bush is generally swaged over and this burring must be filed off flush with the drum. The drum may then be levered off with a screwdriver, and the tuning shaft now removed. If a lathe is available a new shaft may be made with a finer groove in it, or failing that, the old shaft may be squeezed together slightly in a vice. Tapping the shaft on the end with a hammer doesn't really work out very well, for unless you are lucky enough to hit the shaft dead squarely it will pinch the groove on one side and widen it on the other. Before assemling the dial just make a trial run round the friction edge of the drum with the tuning shaft to ensure that it pinches the drum properly and does

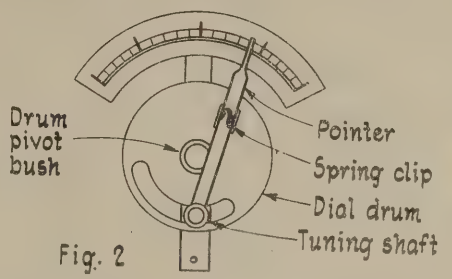

Fig. 2

not bottom at any stage. If it is satisfactory the dial may be assembled, making sure that the tuning shaft groove is sitting on the drum friction edge correctly. Tap the drum pivot bush into position through the hole in the dial drum, making sure to get the three little locating nicks into position. The bush may then be soldered securely to the drum and the pointer slipped back into its correct guide held by the spring clip. If the job is done carefully the dial should be serviceable for many more years.

A lesser cause of trouble is sometimes caused by the tuning shaft spring loading mechanism sticking. The shaft is held hard against the dial drum by means of a short powerful spring and a carrier block. If this carrier block sticks there is no pressure between the drum and the tuning shaft and slipping occurs. If the carrier block is lubricated and levered up and down a few times it is generally sufficient to start things working again.

In conclusion, a point to watch is that dial slip in old sets can very often be caused by the gang condenser stiffening up through rusting ball-races or grease solidifying with the passage of years.

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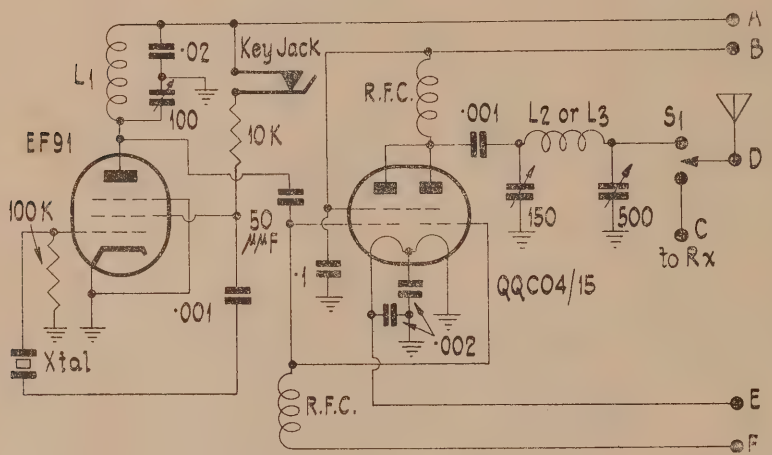

Fig. 1.—Circuit of the transmitter. It operates on 80 and 40 metres, either by doubling in the plate circuit of the EF91 and using the final as a straight amplifier on 40 m., or by using a 40 m. crystal and tuning L_1 to 40, with the final still operating "straight."

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INTRODUCTION

Mobile operation of the amateur bands has always had its adherents and its own peculiar fascination. This is probably accountable for because of the more or less unpredictable nature of the results. As often as not, these are liable to be quite spectacular even with low-powered transmitters and simple receivers, but in any case, operation away from the well-known fixed location of one's home, adds just that spice of the unknown which makes every stopping-place a new adventure! Besides, mobile operation takes in such serious pursuits as the provision of communication facilities in times of national or local emergency, so that the possession of well-designed and constructed mobile equipment, ready to go on the air at a moment's notice, is not merely another way of deriving pleasure from an excellent hobby, but can frequently be of real service to the community at large. It is probably true to say that more and more amateur transmitters would build mobile outfits were suitable designs available, so that it is to cater for this relatively neglected branch of amateur activity that this series of Experimenter articles has been designed.

REQUIREMENTS FOR MOBILE GEAR

As soon as requirements are mentioned, most of us automatically tend to think in terms of how many watts output can be crammed into a small space, and this matter is certainly one which must be given serious consideration, but there are many other things to be thought of. No less important than the transmitter is the receiver, since a sensitive and stable receiver is essential under outdoor conditions, and especially so when the said conditions are emergency ones. Just as important as the transmitter and receiver is the aerial to be used, while nothing can work properly unless there is a suitable source of power available. What all this boils down to is that the complete station is an integrated system, and not just a collection of isolated bits. Accordingly, for the best results, it should be designed as such.

There are a number of basic requirements that any station must fulfil: reliability, ease and speed of operation and maintenance, choice of 'phone or C.W., and so on into the purely technical side of things. Of these, the first two are probably the most important of all, provided that all other requirements, such as power output and receiver sensitivity are reasonably complied with. Nothing is more calculated to detract from the enjoyment of field activities than the need for "tinkering" in order to make things work properly, or for carrying out maintenance work that could have been avoided by better design, while in emergency work, this sort of activity could be disastrous. Considerable point is lent to these remarks by the remarkably solid mechanical work that was invariably put into field equipment used by the armed services, and to some degree at least, similar considerations apply to amateur gear that is to be used away from normal constructional and repair facilities. We do not mean that everything should be "built like a battleship," but it *is* essential that a good solid constructional job be made of everything in a mobile station. By the same token, it is advisable to use simple, standard circuitry wherever possible, steering well clear of "trick" arrangements whose place is only on the experimental bench. Mechanically, the design must be such that routine maintenance operations must be capable of being carried out in the shortest possible time, and with the minimum consequential need for tricky adjustments. For example, it should not be necessary to disassemble the whole rig in order to replace valves, and once they have been replaced, there must be a minimum of internal adjustment

required before the equipment is fully operational once more.

Such things as have been discussed in the last paragraph clearly concern the mechanical design of the equipment as much as its electrical design, so that time and effort spent both in planning and making the finished article will definitely pay dividends. If we have appeared to expend a disproportionate amount of space on these things, it is purely a reflection of our own idea of their ultimate importance.

ELECTRICAL FEATURES

First of all, there is the question of what frequency range shall be covered by the station to be built. If our topography were different, there might be some point in building for one of the lower V.H.F. bands. As it is, V.H.F. would be useful only under certain rather severely limited sets of circumstances, so that for general all-round utility, a choice of frequency will have to be made from the H.F. bands. Since we are faced with working over anything from very short to very long ranges, both at night and during the day, the logical choices are for 3.5 and 7 mc/sec. For special purposes, the 14 mc/sec. band might be desirable, but it was felt that to make the whole system cover three bands would add unnecessary complication, without adding so very much to the utility of the device. It was decided, therefore, to cover the 80 and 40 metre amateur bands.

Next, the transmitter comes up for consideration. Is it to have a V.F.O. or should it be crystal-controlled? How many watts should be aimed at? How many stages should it have? What type of modulation should be used? All these questions must be answered, but unfortunately, not one of them is capable of being resolved one way or the other without shadow of doubt. The alternatives that we have chosen will certainly not make up the ideal system. Features left out will have much to recommend them, while there will be arguments against some that have been included. We do think, though, that the approach we have used is an eminently practical one, and that the equipment that has been evolved will answer most people's requirements.

THE TRANSMITTER

The design of any transmitter is largely conditioned by the choice of the valve for the final amplifier. In the Philips range, there is a valve which has been specially designed for just such applications as we have in mind. It is the QQC04/15. This is a double tetrode which has a low-consumption quick-heating filament instead of a heater-cathode, thereby saving precious watts from the primary source of power. The rated filament voltage is 6.3, but it is noteworthy that the valve will work satisfactorily with a filament voltage as low as 5.5 volts, and that the life is unaffected by filament voltage variations of plus and minus 10 per cent. It has a total plate dissipation of 16 watts under I.C.A.S. conditions, and so is capable of putting a very healthy signal on the air. The maximum cathode current is 100 ma., the maximum plate voltage is 400, and the maximum screen voltage 250. Under Class C amplifier conditions, it needs only 4.2 ma. of grid current, and a driving power less than 0.5 watts. These figures on their own tell the story of the suitability of the QQE04/15 for mobile applications. In addition, the tube is flexible in its H.T. requirements. Up to 400v. may be used, but useful output can be obtained with only 250 volts, when for a plate and screen current of 86.5 ma., an output of 13.4 watts can be obtained.

The transmitter circuit, given here, is exceedingly simple, consisting of a pentode crystal oscillator and the output valve. The purpose of this arrangement is twofold. First, the number of controls is minimized, and secondly, using the smallest possible number of stages allows as much as possible of the available plate power to be used in the output stage, and therefore giving the most power output for the limited amount of D.C. power available. The Philips QQE04/15, used in the final amplifier, is connected with its sections in parallel. This may seem rather odd, since this valve was designed specially for push-pull circuits, but it has been done with good reason. Obtaining push-pull drive for the final would have been simple enough, but push-pull output circuit would have unduly complicated the aerial circuit. In a fixed installation, where balanced feeders can easily be used, or in situations where an aerial tuning circuit can be employed, fed by a short transmission line, the push-pull output connection would not matter. Indeed, under these circumstances, the advantages of a push-pull final can be realized to the full, but here, where the operator will always want to use the simplest possible aerial coupling arrangements, push-pull output would be something of a nuisance. We expect that most users of the circuit will use either a temporarily erected wire of random length, or else a whip, and since both these types of aerial are single-ended, by far the simplest feed arrangements can be made if a single-ended tank circuit is used. At the low frequencies used for this transmitter, there is no disadvantage in using the sections of the QQE04/15 in parallel.

The oscillator circuit is an electron-coupled Pierce, with the screen of the Philips EF91 acting as a plate of the Pierce circuit, and the plate used as a pick-off electrode. This arrangement is extremely efficient both at the fundamental frequency of the crystal, and at its second harmonic. As a result, it is possible to work both the 80 and 40 metre bands with an 80-metre crystal in the socket. It is equally possible, of course, to use a 40-metre crystal, because the amplifier and oscillator are both perfectly stable when working straight through on the fundamental crystal. This gives a choice of either 80 or 40-metre crystals for working on the higher band, and has the advantage that, if desired, only one crystal need be used, as long as it doubles to a frequency inside the 40-metre band. The screen of the EF91 is fed through a 10k. dropping resistor, which at the same time acts as the necessary impedance at R.F. across which the output of the oscillator section is developed. This scheme enables screen keying to be used, so that the plate voltage is applied to the oscillator continuously, but until the screen is keyed on, there is no plate current at all. It was thought that a simple scheme like this would probably be subject to keying "chirps," especially as the screen of the oscillator is fed from a dropping resistor rather than from a voltage divider, but in practice, it was found to work admirably, and to produce a very clean note indeed. The power in the keying circuit is very small, owing to the minute screen current of the EF91, and as a result, the circuit is very free from key clicks, too. Indeed, the C.W. note of this simple little transmitter is considerably better than is often heard on the amateur bands, from transmitters with much better

(Continued on page 33)

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AERIALS AND TRANSMISSION LINES

The classical loop aerial consists of several turns of wire and efficiency decreases with size. The introduction of magnetic materials suitable for high frequencies made it possible to concentrate, in a small rod, the magnetic flux from a large area, thus reducing the size of the loop to a small rod. In this paper the effects of various parameters on the performance of an aerial rod are discussed, particularly with reference to "Ferroxcube" aerial rods.

—*Philips Electronic Application Bulletin* (Netherlands), Vol. 13, No. 6, p. 88.

Methods of transmitting the circular electric wave around bends. The tendency for energy to be converted out of the circular electric wave in a bent round pipe may be avoided by one of three general approaches, and these three are discussed. Elliptical guide and special waveguide structures may be used to negotiate intentional bends.

—*Proceedings of the I.R.E.* (U.S.A.), September, 1952, p. 1104.

Because of the increase of speed of modern aircraft, there has arisen a need for the elimination of the drag of external aerials. A common form is the slot cut in the metallic skin of the aircraft, the slot behaving in a manner which is comparable to that of the conventional dipole. Polar diagrams and general effectiveness is given.

—*Proceedings of the I.E.E.* (Eng.), Part III, No. 60, p. 187.

AUDIO EQUIPMENT AND DESIGN

The development of a modern pre-amplifier leads to many problems from the standpoint of hum, noise, stability, and overload characteristics. The pre-amplifier design presented meets these requirements. If a complete radio-phonograph system is under consideration, the amplifier may be used as a concealed unit to simplify the complete operation of the home system.

—*Electronics* (U.S.A.), July, 1952, p. 121.

A tone-burst generator checks A.F. transients; transient distortion is a factor least frequently measured, and the loudspeaker enclosure is the most serious contributor to this type of distortion. With the recording system described, transient and steady rate curves are drawn with the same recorder, with a view to an evaluation of transient effects.

—*Ibid*, p. 132.

The "Williamson Type" Amplifier brought up to date; initial tests indicated that four major sources of noise, distortion, and poor transient response limited the optimum capabilities of the generally used circuit. These were met by first stage improvements, phase splitter improvements, and attention to constructional details.

—*Audio Engineering* (U.S.A.), August, 1952, p. 18.

The life cycle of sound energy involves generation, transmission, and finally, dissipation in the form of heat, and an important concept is acoustic impedance, a general term which may be used in connection with electrical, mechanical, acoustical or other types of oscillatory energy. The article deals with these important concepts from the view of general physics, and introduces the reader to acoustic resistance, mass, and stiffness.

—*Ibid.*, p. 20. Also: July, 1952, p. 15.

The constant search for better and cleaner bass response has progressed through a long list of cabinet types. The author reviews the most common of them and describes their performance characteristics.

—*Ibid.*, p. 24. Also: July, 1952, p. 31.

Universal design curves for tone control circuits—the second and third series of the articles continue a very valuable synopsis of information for the design of these circuits.

—*Radio and Television News* (U.S.A.), August and September, 1952.

CIRCUITS AND CIRCUIT ELEMENTS

The relationship between the applied voltage and the current flowing through a voltage dependent resistor is such that the voltage increases much less linearly than the current, or it is independent of frequency. By means of a VDR resistor, therefore, modifications of sawtooth voltages can be arranged. In the paper a frame deflection circuit is discussed which takes advantage of this feature.

—*Philips Electronic Application Bulletin* (Netherlands), Vol. 13, No. 7, p. 101.

ELECTRONIC DEVICES

The electric fence; some discussion has ensued as to why mains-operated electric fences are not permitted, with general notes, safety regulations and the design of a fence controller using a thyratron which obviates moving parts.

—*The N.Z. Electrical Journal*, October, 1952, p. 813.

INSTRUMENTS AND TEST GEAR

An article in September gave an interesting account of precision standards obtainable with crystals. The author now describes a high-precision 100 kc/sec standard, and with a detailed description of the Meacham Oscillator. A goal of one part in ten million was set, and has been exceeded.

—*QST.* (U.S.A.), October, 1952, p. 26.

With a view to combining theory and practice in instructing a very simple galvanometer can be devised, using a magnetic compass. This can be turned to various simple forms of primary cells using the familiar materials, copper, zinc, iron, aluminium, carbon, etc. Very interesting instruction can be given on primary cells, polarization, etc.

—*Ibid.*, August, 1952, p. 643.

The need for a pure sine wave has been apparent since the first distortion measurements were made; the oscillator described is designed to give a very accurate wave form, and the secret is meticulous construction details.

Ibid., p. 13.

MATERIALS, VALVES, AND SUBSIDIARY TECHNIQUES

A gravity Daniell cell makes an excellent and instructive toy for a boy; the materials are few—a jar, a handful of copper sulphate, copper and zinc. Comparatively large currents can be drawn from the cell which has a long life and presents no hazards or fumes. Another type is the Salande-Chaperon—requiring only sheet metal, iron trimmings and some caustic soda.

—*The N.Z. Electrical Journal*, September, 1952, p. 737.

A radically different type of magnetron is described, in which the positions of the cathode and anode segments are inverted from the ordinary position, the cathode being a cylindrical outer cylinder. This gives greater emission and high electronic efficiency.

Proceedings of the I.R.E. (Eng), September, 1952, p. 1038.

A survey of transistor development. In particular the article deals with the ratio of impurities necessary in the germanium if the action is to be satisfactory, and there should not be more than one atom of impurity to some ten million germanium atoms. The crystal-growing process is covered, and the theory of conductivity, with notes on the fabrication process for the practical transistor.

—*Radio and Television News* (U.S.A.), September, 1952, p. 43.

Two French scientists have developed a new type of electrostatic generator of light weight and ruggedness; a generator with an output of 4 ma. gives a direct current at 50,000 volts and apparatus for higher voltages is under test. The principle is that if a variable condenser while in the closed position has an electrical potential placed upon it and then the condenser is rotated the voltage will rise. It seems that such an arrangement can be cascaded, and by commutation, an A.C. or a D.C. voltage can be obtained.

—*Radio and Television News* (U.S.A.), September, 1952, p. 59.

A variable-voltage power supply is a basic piece of equipment, and one can do much better than to keep putting resistors in series with a fixed supply. Small thyratrons are used for the dual purpose of rectification and control. Theory and design of the equipment given.

—*Ibid.*, p. 66.

MATHEMATICS

The constants of a "T" or "pi" type constant K low-pass filter may be determined rapidly and with acceptable accuracy with the aid of a chart given.

—*Ibid.*, p. 54.

PROPAGATION

Some aspects of microwave fading on an optical path over sea; this is of special interest as the tests were made across Cook Strait, from Seddon to Wellington. The article refers to the variation of gradient of a refractive index—sub-refraction and super-refraction; variations of refractive index caused by turbulence, duct formation, combined lobe-bending and turbulence. From the evidence it is shown that deep fading is caused by the simultaneous occurrence at random of two conditions, exact phase opposition between direct ray and indirect ray, and on the distribution of discontinuities of the refractive index of the path.

—*Proceedings of the I.E.E.* (Eng.), Part III, No. 61, p. 236.

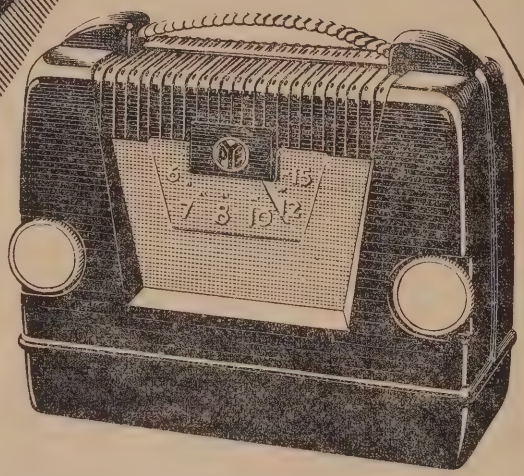
Symposium of papers on microwave links. A number of papers are given dealing with present day techniques.

—*Ibid.*, p. 241.

Cosmic radio noise intensities in the V.H.F. band. Radio noise emanating from extra-terrestrial sources constituted one of the limiting factors for radio communications. This type of noise was identified as a characteristic hissing apparently originating at a fixed point in space near the centre of our galaxy. In addition the sun itself is a radiator of noise. The paper deals with an evaluation of these noise intensities.

—*Proceedings of the I.R.E.* (U.S.A.), September, 1952, p. 1053.

(Continued on Page 48.)



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TUBE DATA: The R.F. Pentode EF80—(Continued)

4. The EF80 as Video Amplifier

The normal direct-view picture tube requires a maximum drive voltage of about 60V. peak-to-peak, including sync. signal, derived from the video stage. This signal can be delivered by an EF80 operating with cathode compensation. In the case of a projection tube, however, which requires a drive voltage of about 100V. peak-to-peak, a considerably greater anode current swing is required with the same anode load. It is then advisable to use the PL83.

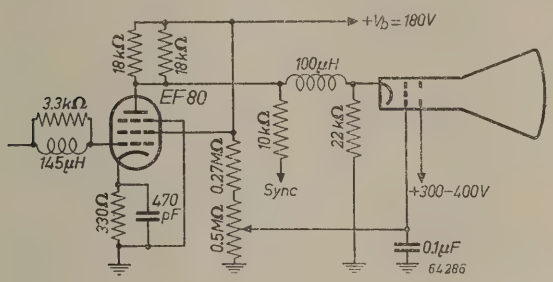

Fig. 6.—The EF80 as a video amplifier with cathode compensation.

A suitable circuit with the EF80 for driving a picture tube of the direct-viewing type is given in Fig. 6. Under quiescent conditions the tube is operated at an anode current of 6.5 mA. and a screen-grid current of 1.8 mA. for 60V. peak-to-peak output voltage an anode current swing of 9.4 mA is required. The gain of the stage is 12.

A series peaking coil of 145 μH shunted by 3300 Ω resonates with the input capacitance of the EF80 at about 5 mc/sec., thus improving the response at the high video frequencies. Moreover, I.F. frequencies are attenuated by this series circuit. The shunt resistor is included to prevent overshoot. It is assumed that the black level of the input signal is at chassis potential.

In this stage cathode compensation has been applied by shunting the cathode resistor with a capacitor of 470 pF. At high frequencies the negative feedback caused by the cathode resistor decreases as a result of the by-passing effect of the capacitor, this compensating the loss in gain due to parasitic capacitances in the anode circuit. This compensation is effective up to 3.5 mc/sec.

A series peaking coil of 100 μH between the anode of the EF80 and the cathode of the picture tube extends the frequency characteristic to about 4.5 mc/sec. The self-capacitance of this coil should be small, and wave winding is therefore recommended.

The output signal of the video stage is applied to the syn. separator via a resistor of 10 kΩ, thus preventing an increase in the capacitance of the anode circuit. Since direct coupling is used between the EF80 and the cathode of the picture tube, a positive variable potential can be applied to the grid for the brightness control (0.5 MΩ potentiometer). A direct voltage of 300–400 V. with respect to the chassis is required for the first anode of the picture tube. In a receiver with a high-tension line voltage of about 180 V., this voltage may be taken from the booster capacitor in the line output circuit.

TECHNICAL DATA

Heater Data:
Heating: indirect by A.C. or D.C.; series or parallel supply.

Heater voltage	V_f	6.3 V
Heater current	I_f	0.3 A

Capacitances:

C_{g1}	7.5 pF
C_a	3.3 pF
C_{ag1}	<0.007 pF
C_{ak}	<0.006 pF
C_{g2}	5.4 pF
C_{g1g2}	2.6 pF
C_{g1f}	<0.15 pF
C_{kf}	5.0 pF

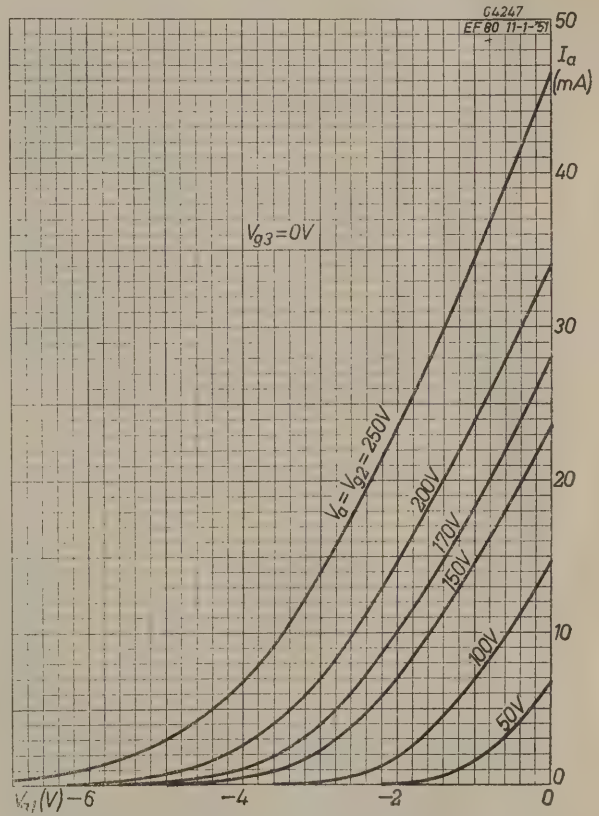

Fig. 8.—Anode current plotted against control-grid voltage for anode and screen-grid voltages between 50v. and 250v.

Typical Characteristics

Anode voltage	V_a	170	200	250 V
Suppressor-grid voltage	V_{g3}	0	0	0 V
Screen-grid voltage	V_{g2}	170	200	250 V
Control-grid voltage	V_{g1}	—2	—2.55	—3.5 V
Anode current	I_a	10	10	10 mA
Screen-grid current	I_{g2}	2.5	2.6	2.8 mA
Mutual conductance	S	7.4	7.1	6.8 mA/V

(Continued on Page 31.)

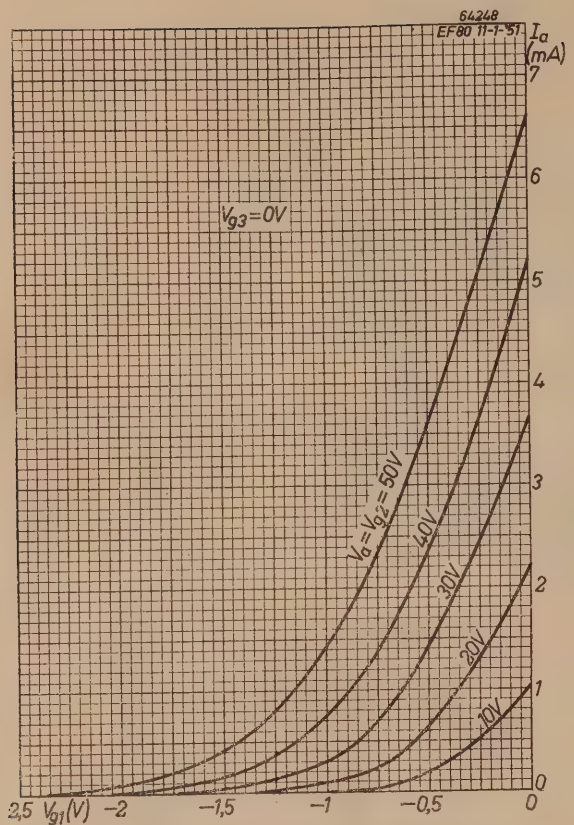

Fig. 9.—Anode current plotted against control-grid voltage for anode and screen-grid voltages between 10v. and 50v.

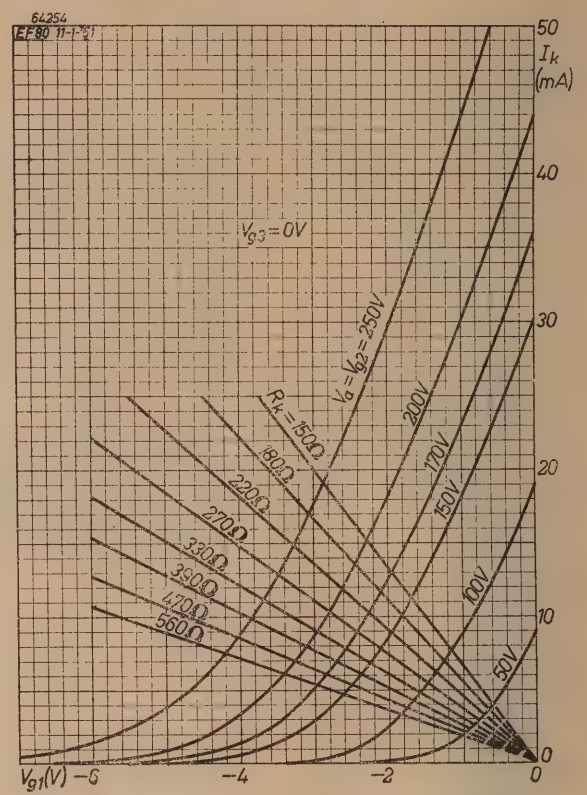

Fig. 10.—Cathode current plotted against control-grid voltage, with anode and screen-grid voltage as parameter.

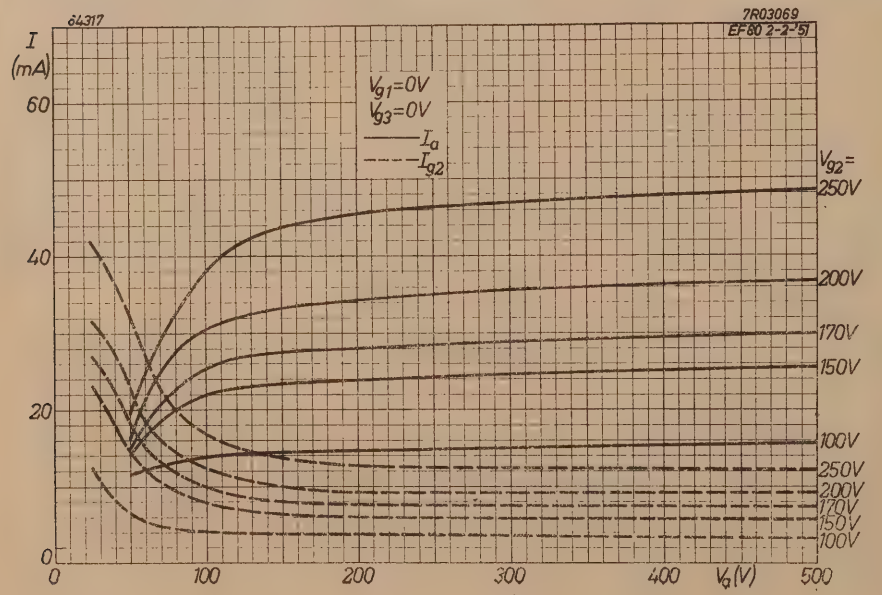

Fig. 12.—Anode current and screen-grid current plotted against anode voltage for control-grid voltage of 0v., with screen-grid voltage as parameter.

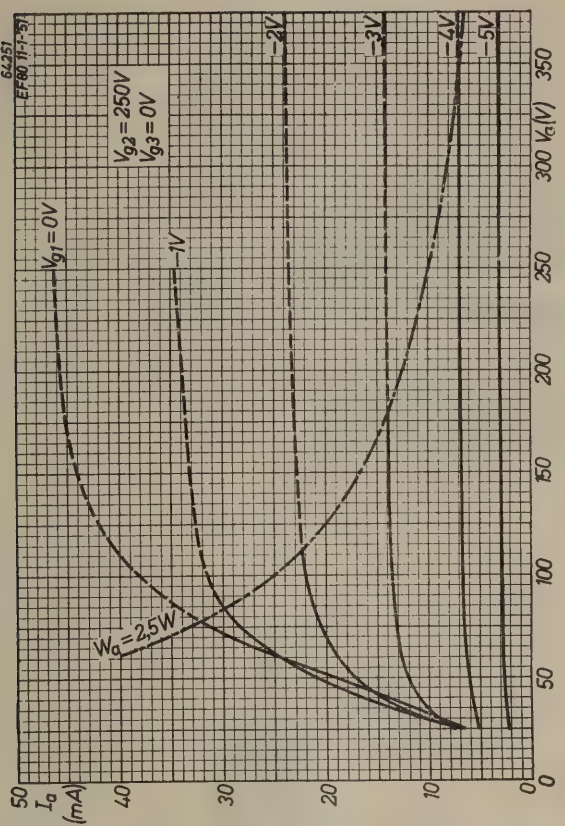

Fig. 11.—Anode current plotted against anode voltage for screen-grid voltage of 250v., with control-grid voltage as parameter.

Internal resistance	R_i	0.5	0.55	0.65 MΩ
Amplification factor between screen grid and control grid	μ_{g2g1}	50	50	50
Equivalent noise resistance	R_{eq}	1	1.1	1.2 kΩ
Input damping at 50 mc/sec. (socket pins 1 and 3 interconnected)	r_{g1}	10	12	15 kΩ

Limiting Values

Anode voltage at zero anode current	V_{ao}	max.	550 V
Anode voltage	V_a	max.	250 V
Screen-grid voltage at zero screen-grid current	V_{g2o}	max.	550 V
Screen-grid voltage	V_{g2}	max.	250 V
Control-grid voltage (grid current + 0.3 μA)	V_{g1}	max.	−1.3 V
Heater voltage during the warming-up period		max.	9.3 V
Voltage between heater and cathode	V_{kf}	max.	150 V
Cathode current	I_k	max.	15 mA
Anode dissipation	W_a	max.	2.5 W
Screen-grid dissipation	W_{g2}	max.	0.7 W
External resistance between control grid and cathode—with self bias	R_{g1}	max.	1 MΩ
with fixed bias	R_{g1}	max.	0.5 MΩ
External resistance between heater and cathode	R_{kf}	max.	20 kΩ

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Philips Experimenter

(Continued from Page 25.)

buffering between the oscillator and the final amplifier.

The circuit of the final amplifier is a little unusual, in that it shows fixed bias, and shunt feed of the plate circuit, with the plate tank circuit arranged as a π-section network. This is a most effective method of obtaining a match between the plate circuit of the valve and any aerial or transmission line that is fed at one point only. We have recommended the method before in these pages, but mainly for use at very high frequencies, where the problem was to match to the impedance of a co-axial cable. Here, however, it shows to even better advantage. It is capable of effecting the most efficient possible match to any piece of wire we may like to attach to the output terminal and grace by the name of Aerial. How efficiently the said piece of wire will act as a radiator is another matter entirely, and one which is of no concern whatever to the coupling device, but the fact remains that the π-section coupling system will enable the final amplifier to be loaded by anything we may choose in the way of an aerial, and for this particular purpose, this facility is a most important one to have. Indeed, it is a system that could well find a great deal more use in amateur circles than it actually does. Contrary to popular belief, it is not difficult to adjust, since a simple procedure enabling the greatest aerial current to be produced, automatically ensures that the best matching is arrived at at the same time. In a case like this one, where we do not want to use a special aerial coupler, it also effects a considerable saving of parts, and a saving too in the time needed to set up for transmission once one is "on location."

Included in the circuit diagram are the keying jack, already referred to, and the aerial change-over switch. Voltage supply points have been shown as terminals labelled each with its own letter. The purpose of this is to enable the succeeding diagrams concerned in the complete station, to be added in such a way that no modification is necessary to the individual drawings.

For instance, A is the H.T. supply for the oscillator, and B, that for the final. These must be separated, since B will have to go to the modulator while A can go straight to the power supply. E, the filament supply lead for the final, must leave separately from the "hot" end of the heater supply for the oscillator, since the final's filament will be turned on by the Send/Receive switch, which will be located in the receiver for convenience in operating. F goes to the source of fixed bias for the final, which is a miniature 67½-volt battery, as used in battery sets for B supply. C goes, via a short length of co-axial cable, to the input terminal of the receiver. The switch S_1, can, if desired, be a separate switch, mounted on the transmitter, but in the prototype is a pair of contacts on a low-capacity relay, which is mounted on the transmitter chassis, and operated from the filament supply by the Send/Receive switch on the receiver panel. From this, it can be seen that the station has been designed as a whole, with a view to operating convenience, rather than just as a small transmitter and receiver, entirely unrelated in any way.

(To be continued.)

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TRADE WINDS

TV DEVELOPMENTS IN BRITAIN

A recent advice from England informs us that Mr. C. O. Stanley, C.B.E., Managing Director of the Pye group of companies, has been invited to join the newly formed Television Advisory Committee. This committee was formed following the renewal of the Charter of the B.B.C., under somewhat different terms of reference from those of the previous Charter. Readers will remember that the way is now open for commercial TV to be started in Britain, in competition with the B.B.C. service, and one of the Television Advisory Committee's functions will be to advise the Postmaster-General on the institution of competitive television services, television for public showing in theatres, etc., and on all matters concerning TV and sound broadcasting at frequencies higher than 30 mc/sec.

These terms of reference indicate that the Advisory Committee will probably have a marked effect on the development of broadcasting in the United Kingdom, both in radio and television.

As well as representatives of the radio industry, the committee comprises representatives of the British Post Office, the B.B.C., the Treasury, and the Ministry of Supply.

A television development in Britain that has not yet received much publicity is the formation of High Definition Films, Ltd., a company whose objective is the production of films solely for use as "canned" television programme material. Their studios are due to open this year, and will be the first studios to employ electronic cameras, specially developed for the purpose by Messrs. Pye. The chairman of High Definition Films is Mr. Norman Collins, who until recently wacs Controller of the B.B.C. Television Service. Mr. C. O. Stanley is also on the board.

* * *

Britain is not idle in the matter of overseas television trade. Recently a new company, Associated Broadcasting Development Co., Ltd., has been formed with the object of developing TV and sound radio throughout the world, both on the technical and programme sides. The board of this company includes such well known people as Sir Robert Renwick, Sir Alexander Aikman (chairman of E.M.I.), Sir Alexander Korda, Mr. C. O. Stanley, and Mr. Norman Collins. The company, among others interested, is pressing for the establishment of competitive TV broadcasting, one of its most potent arguments being that such a service would not only give greater programme service to British viewers than the B.B.C. is able to provide, but would form the solid core of a vast potential business in television equipment and programmes outside the United Kingdom.

Developments such as these will have a considerable effect on other countries in the Empire, such as

ourselves, and the availability of "canned" programmes, both from the B.B.C. and from commercial organizations like these two new British companies, may well help to determine how soon television broadcasting starts here.

* * *

From Auckland comes the news of the registration of the New Zealand Radio-Television and Electrical Traders' Association as an incorporated body. The Secretary is Mr. J. E. Beachen; registered address, 24 Customs Street East; postal address, P.O. Box 611, Auckland.

Proud recipient of the latest model 6P2 Pacific Portable is D. L. Woon, shown receiving his "prize" from Mrs. Jack Hodge, wife of the Pacific radio dealer in Wanganui, at the close of the Castlecliff pre-championship golf tournament.

* * *

On account of the rapidly increasing demand for their product, Messrs. H. J. Enthoven and Sons, Ltd., of England, manufacturers of Superspeed Cored Wire Solder and other allied products, have recently found it necessary to form a subsidiary company, known as Enthoven Solders, Ltd. Although owned wholly by the parent company, its policies will be determined by an independent board, and an aggressive attack on all the world's markets is being commenced.

PUBLICATIONS RECEIVED

Publication No. 560, EHT Concentric Connectors, The Plessey Co., Ltd., England. (Swan Electric Co. Ltd.)

Booklet V1169, G.E.C. Table and Bracket Fans: General Electric Co., Ltd., England. (British General Electric Co., Ltd.)

Muirhead Technique, Vol. 6, No. 3, July, 1952: Muirhead & Co., Ltd., England. (Richardson McCabe & Co., Ltd.)

Ham News, Nos. 4 and 5, Vol. 7: General Electric Co., U.S.A. (National Electrical and Engineering Co., Ltd.)

Brochure, GLASEF (P.T.F.E.) Aircraft Wiring Cables: British Insulated Callenders Cables, Ltd., England. (National Electrical and Engineering Co., Ltd.)

Stock Record, November, 1952: Cory Wright & Salmon, Ltd.

A.P.A.E. Journal, October, 1952: Association of Public Address Engineers, England.

Catalogue "Loudaphones" Calling Systems: Clifford & Snell, Ltd., England. (Electronic Controls & Appliances, Ltd.)

Catalogue, Thermometers, Relays, etc.: Electric Methods, Ltd. (Electronic Controls & Appliances, Ltd.)

Various publications from Decca Radar, Ltd., England (Electronic Navigation, Ltd.), including—

Decca Radar Link Type 2.

The Decca Navigation System.

Decca Harbour Radar Type 31.

The Decca Navigator.

Aircraft Equipment Issue 4.

Philips Technical Review, January and February, 1952.

Philips Electronic Application Bulletin, June and July, 1952. N.V. Philips Gloeilampenfabrieken, Eindhoven, The Netherlands. (Philips Electrical Industries of N.Z., Ltd.)

Radiotronics, November, 1952: Amalgamated Wireless Valve Co., Ltd.

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H.M.V. portable 4-valve battery model 484P, serial No. 21184. Metal cabinet, green flock finish, cream plastic base and top, 9 in. x 4 in. x 3½ in. Leather carrying handle. Minimax battery 467, 2 Eveready torch batteries 950.

Ultimate radio gramette, 5-valve, serial No. R.A.C. 142255, licence No. 5/13318. Walnut veneer cabinet 11⅜ in. x 15⅛ in. x 19¼ in., hinged lid on top. "Garrard" type single player, 10 in. turntable.

Bell battery/electric portable, serial Nos. BP 1583 and 3166. Plastic cabinet 10 in. x 8 in. x 5 in. with tan varnish finish, speaker opening on left side with 5 or 6 bars across opening. Dial on right. Two tuning knobs. Switch upper left corner. Brown plastic handle.

Philips 5-valve battery/electric portable. Mottled brown rexine finish, 15 in. x 12 in. x 6 in., two control knobs on front and switch on side. One of bakelite fittings for handle broken.

Regent, 4-valve battery portable, serial No. 9904. Deep green bakelite case, 9 in. x 4 in. x 4 in., screw on back, white plastic handle, two brown tuning knobs, small square dial clear plastic.

FOR THE SERVICEMAN

On the opposite page is the circuit of the Mullard Model 420.

Criminal Investigation Branch, Palmerston North

Courier 4-valve, serial No. 9072. Cream bakelite cabinet 10 in. square x 3½ in. deep.

Police Station, Taranaki Street, Wellington

Bell 4-valve battery/electric portable, serial No. 1835/6632. Ivory plastic cabinet with three white knobs (battery/power, volume, and tuning).

Mount Cook Police Station, Wellington

Mullard 5-valve dual-wave portable No. 13759, housed in Philips cabinet 14 in. x 6 in. x 6 in.

Police Station, Wanganui

Motorola 6-valve auto radio, serial No. 6617. Brown metal case with separate speaker.

(Continued on Page 48.)

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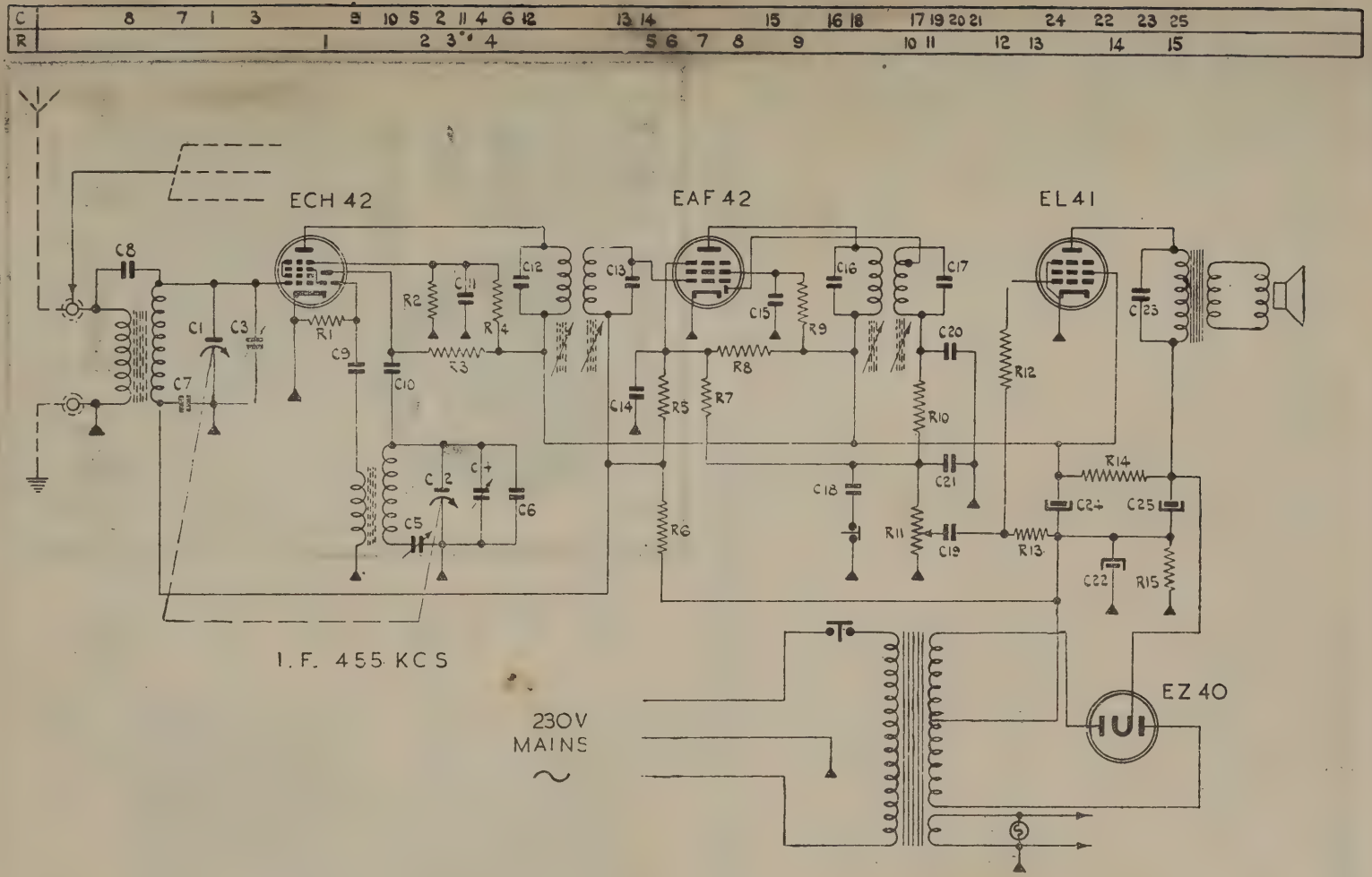

C.1	Ganged Tuning Condenser	C.11	.02 mfd. 400 v. paper	C.21	100 mmfd. ceramic	R.6	2.2 m. ½ watt
C.2	13-496 mmfd.	C.12	110 mmfd. ceramic	C.22	100 mfd. 10 v. electrolytic	R.7	1 m. ½ watt
C.3	3-30 mmfd. Trimmer	C.13	110 mmfd. ceramic	C.23	.004 mfd. 400 v. paper	R.8	15 m. ½ watt
C.4	3-30 mmfd. Trimmer	C.14	.02 mfd. 400 v. paper	C.24	50 mfd. 350 v. Double	R.9	100 K. ½ watt
C.5	150-750 mmfd. Padder	C.15	.01 mfd. 400 v. paper	C.25	50 mfd. 350 v. electrolytic	R.10	50 K. ½ watt
C.6	10 mmfd. ceramic	C.16	110 mmfd. ceramic	R.1	47 K. ½ watt	R.11	½ meg. volume control
C.7	.05 mfd. 400 v. paper	C.17	110 mmfd. ceramic	R.2	47 K. ½ watt	R.12	10 K. ½ watt
C.8	5 mmfd. ceramic	C.18	.0014 mfd. 400 v. paper	R.3	25 K. ½ watt	R.13	500 K. 1 watt
C.9	56 mmfd. ceramic	C.19	.01 mfd. 400 v. paper	R.4	25 K. 1 watt	R.14	2,200 ohms. 2 watt
C.10	150 mmfd. ceramic	C.20	100 mmfd. ceramic	R.5	750 K. ½ watt	R.15	150 ohms 1 watt

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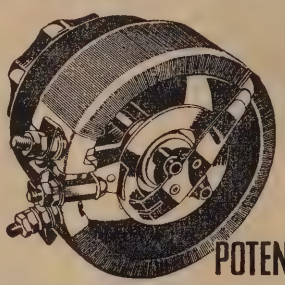

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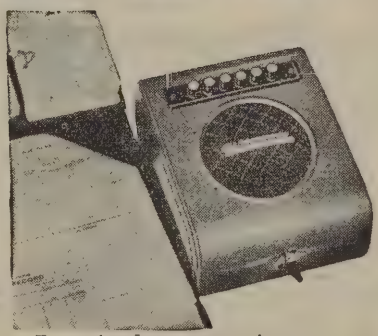

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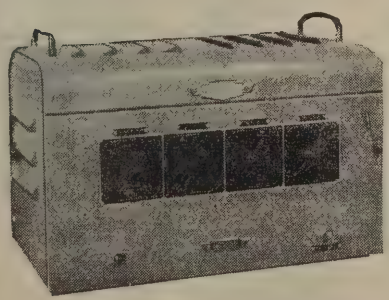

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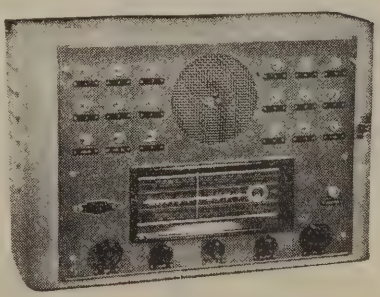

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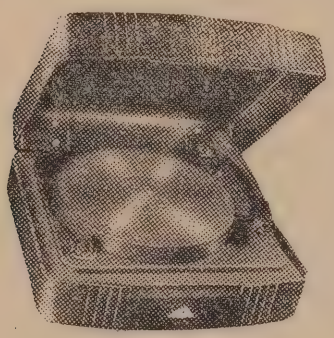
Model 52 G.U.

This attractive H.M.V. record player, fitted with a 3-speed motor unit is the means of turning your table model H.M.V. radio into an inexpensive, space-saving armchair radiogram. Reproduction of recordings by the lightweight pick-up is of an exceptionally high standard both on standard and long-playing discs.



Specifications:

Power supply: 240 volts A.C.

Cabinet: Height, 5⅜in.; depth, 13 in.; width, 14½ in.

Gross weight, 15lb.

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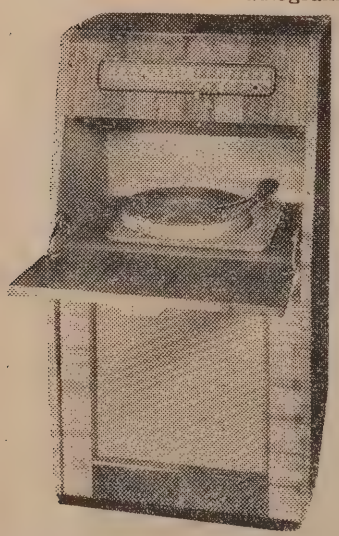
Model 526 D/C1, 6-Valve Dual-wave Console Radiogram



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SPECIFICATIONS

Valve Complement:

(1) 7B7—R.F. Amplifier.
(2) 7S7—Mixer Oscillator.
(3) 7B7—I.F. Amplifier.
(4) 7C6—2nd Detector.
(5) 7C5—Audio Output.
(6) 7Y4—Rectifier.

Frequency Range:

(1) Broadcast—530-1520 kc/sec.
(2) Shortwave—6–19.5 mc/sec.
(3) I.F. frequency—455 kc/sec.

Power Supply:

Mains: 230 volts 50 cycles.
Power consumption: 75 watts.

Cabinet:

Width, 20 in.; height, 2 ft. 11¼ in.; depth, 16¾ in.

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Six-Valve Battery Receiver

(Continued from Page 8.)

circuit will not tune correctly, and proper alignment of the set will be impossible.

The R.F. amplifier tube is in the front left-hand corner of the chassis, and thus shows on the right-hand side in the top-chassis photograph. Behind it is the DK40 oscillator-mixer tube, the first I.F. transformer, and the I.F. amplifier valve, which is in the corner of the chassis. Along the back, from right to left (in the photograph) are the second I.F. transformer, the detector and audio valve, and the push-pull input transformer. In front of this are the two output valves. The volume control is not seen in this photograph, but can be seen in the under-chassis view. It is on the right-hand side of the chassis front, with the on/off switch on the opposite side.

In the underneath view, the front of the chassis is at the top of the picture. The battery leads can be seen entering the chassis through a rubber grommet at the right-hand side of the back of the chassis. Close handy is mounted a tag-strip on which the battery leads are terminated, and next to this is the 25 μf. bypass condenser which is connected across the 400-ohm back-bias resistor. This resistor can be seen wired to the two lugs on the tag strip nearest the back of the chassis. The shielded leads to the volume control can be seen crossing the chassis from the small tag strip with two lugs on it, near the detector valve socket. The R.F. and oscillator coils can be seen near the centre-line of the chassis. The one nearest the front edge of the chassis is the oscillator coil, and next to it slightly to the right in the photo, is the padder condenser. As can be seen, there is plenty of room under the chassis, and most of the small parts are soldered directly to valve pins,

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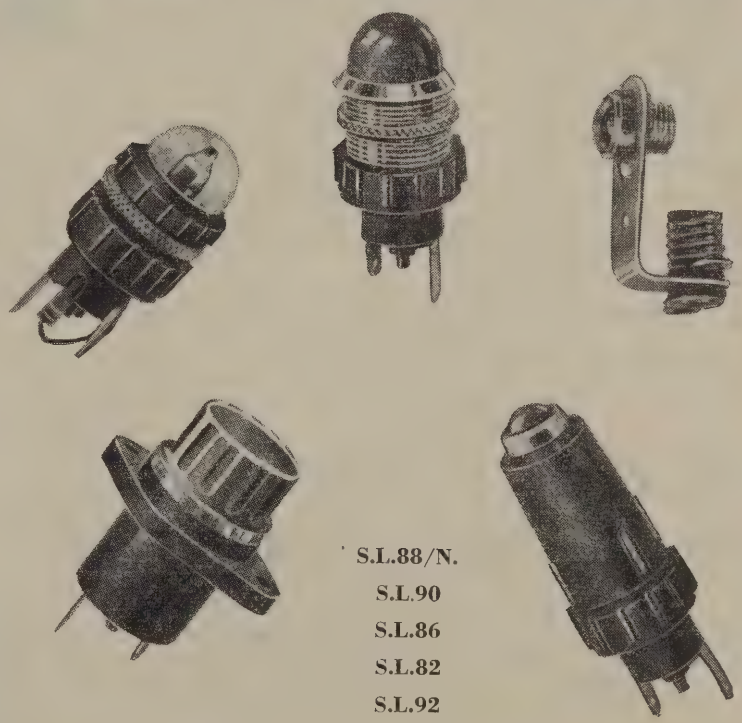

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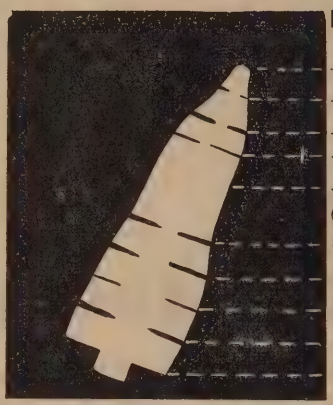

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or to the solder lugs of other components that are rigidly fixed to the chassis.

Where no such fixed tie-points exist, insulated solder lugs are mounted on the chassis so that none of the small parts have one end floating, as it were, in the wiring.

CONSTRUCTING THE ROD AERIAL

The rod of Ferroxcube is only the core for the aerial winding, but the permeability of the rod is so high that only a very few turns are needed to tune to the broadcast band. Ferroxcube is quite a good insulator, and the enamelled wire with which the coil is wound is put on without any intervening layer of insulation, which is quite unnecessary.

The winding is placed exactly in the middle of the rod, and consists of 38 turns of 28 gauge wire. In order to prevent the winding from unwrapping, several turns of Durex cellophane tape are wound round the rod, and the starting end of the coil is butted against the shoulder thus formed. The wire end is held down by taking a couple of turns of the tape round it before finally sticking down the end of the tape. The wire is then wound, and when right number of turns is on, a further layer of tape is put on the rod right up against the finishing end of the coil, and so when finished, the coil finds itesIf firmly held from slipping along the rod by the two shoulders of tape, one at each end of the coil. The finishing end of the coil is likewise held down by a turn or two of the tape forming the shoulder.

Having wound the coil, some means are essential of solidly terminating the ends, so that soldered connections may be made. This is done as follows: The two solder lugs are placed in a piece of tag strip, leaving sufficient space between them for a strip of Durex. The strip is then held over the coil, and several turns of the tape are wound over both strip and rod until the strip is firmly held. This done, the coil wires are soldered to the lugs, and the twisted wires are added, which connect the coil into the circuit. In the top view, the 100k. decoupling resistor and the 0.05 μf. bypass condenser that connect to the lower end of the aerial coil are seen mounted to a tag strip on top of the gang condenser. One end of the coil is terminated on this tag strip, and a lead is taken down through the chassis to the grid of the R.F. amplifier valve. The other lead from the aerial coil is taken to the lug to which the condenser and resistor are wired. From the other end of the resistor a lead is taken down to the A.V.C. circuit.

ALIGNMENT OF THE SET

The alignment of this receiver should not be any different from that of any other conventional superhet, provided that the inductance of the aerial coil is correct. As long as the latter is wound according to the instructions above, there should be no difficulty about this, and the set can be trimmed up in exactly

(Continued on Page 48.)

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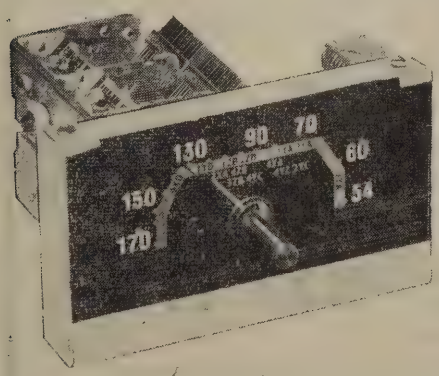

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Proceedings of the New Zealand Electronics Institute Incorporated.

HEADQUARTERS NEWS

The last meeting of the Executive Council was held in the office of the Secretary, A.M.P. Building, on Tuesday, 14th October,. 1952, when, for the first time for several months, a full representation from all districts was secured. Those present included the Dominion President, Mr. B. Withers, who was chairman of the meeting, Messrs. Hurrell and McCormick, Wellington Branch Councillors, Messrs. Foster and Andrews, Combined Branch Councillors, and Mr. B. P. Joseph, Auckland Branch Councillor. A telephone link-up was again established with the Dunedin delegation of Messrs. Shiel and Symmons. The Dominion Secretary, Mr. J. H. McIvor, was also in attendance. Apologies for absence were received from Mr. R. G. Tulloch and S./Ldr. Partelow.

Recognition of Membership Qualifications.—The sub-committee handling this matter reported that approaches had already been made to a Government Department and also to the radio industry. Arrangements were in train to approach the broadcasting authorities, the Public Service Commission, and on a suggestion from Mr. Shiel, it was agreed that the New Zealand Radio and Television Manufacturers Federation also be approached.

Constitutional Amendments.—Authority was granted the Secretary to proceed with the proposed constitutional amendments and a postal ballot will shortly taken place regarding this matter. All members entitled to vote will receive full details of the proposed amendments, and it is to be hoped that if the amendments are carried the progress of the Institute will be substantially accelerated.

Next Meeting.—The next meeting of Council was to be held some time in November.

Subscriptions.—There are still several members who have not yet paid their subscriptions and accounts have been sent to all Branch Treasurers in the hope that they will be able to approach members personally and thus secure the necessary finance to enable the Institute to function successfully.

BRANCH NEWS

Auckland

At the recent Council meeting, Mr. Joseph, of Auckland, advised that difficulty was being experienced in interesting prospective and existing members in the activities of the Institute. It was most discouraging for arrangements to be made for a prominent person to speak to members on some phase of electronic work only to find that the attendance did not exceed, say, six members. This had been the experience in Auckland and those present felt that something should be done to endeavour to assist the Auckland branch in their efforts to further the objects of the Institute.

Christchurch

The last meeting of the Christchurch Branch was held on Monday, 3rd November, at 7.30 p.m. in the Canterbury University College, when Dr. C. E. Ellyatt, Senior Lecturer in Physics, gave a lecture covering experiences of his attendance at the recent world Scientific Radio Conference in Sydney. Further details regarding this interesting address will be made available to members shortly.

Arrangements have been completed for an award for the best lecture given to the branch during 1952–1953 by a student or graduate of the Institute. The general idea is for a short lecture lasting approximately 30 to 40 minutes to be given on any technical aspect of electronics. The Executive Committee will be the adjudicators and this committee's decision will be final. It is proposed also to print a complete programme of future branch activities.

Wellington

At a recent monthly general meeting of the branch a talk was given by Mr. W. L. Harrison, Chief Engineer of the New Zealand Broadcasting Service on a visit to the B.B.C. The address was listened to with great interest and further details will be published in our next issue.

Television Project.—The television technical committee is making very good progress with the branch television project. Recommendations have been made available to members for discussion, and it would seem that the project is one worthy of the support of all members.

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BOOK REVIEWS

Radiotron Designer's Handbook. Edited by F. Langford-Smith, B.Sc., B.E., and published by the Amalgamated Wireless Valve Co. Pty. Ltd., Sydney.

Readers of this or any other radio periodical will need no reminder of the previous edition of this Handbook. First published in 1940, the third edition, which is the immediate predecessor of the present volume, gained a most well-deserved world-wide reputation, selling over a quarter of a million copies, and running through a large number of printings. It is consequently no exaggeration to say that the fourth edition, which is the subject of this review, has been eagerly awaited, ever since it was announced that Mr. Langord-Smith was working on a greatly enlarged and modernized version. The writer, for one, has long been conscious of the dog-eared condition of both his copies of the third edition, and of the usefulness which has been the basic reason for such physical deterioration. Moreover, if the fourth edition, of almost 1500 pages, turns out to be four times as useful as the previous one, with its modest 350, it will indeed be a valuable tome!

It is difficult to know where to start, both in reading a volume like this one, and in describing it. A list of the chapters and their chief subdivisions alone, takes up a full page at the beginning of the book, while the full Contents occupies no less than 31 pages! The inside of the dust-cover describes the book as "A comprehensive self-explanatory reference handbook for the benefit of all

those who have an interest in the design of radio receivers and audio amplifiers." The clue to its character is to be found in the words "reference handbook," for this is what it is, in contradistinction to a text-book. The first chapter, "Introduction to the Radio Valve," is elementary in nature, and the real "meat" commences in Chapter 2, on valve characteristics. This chapter is a considerably enlarged version of the excellent chapter in the previous edition, and covers the ground very fully. The first six sections of this chapter deal with the meanings and definitions of the various characteristics by means of which valve performance may be evaluated, and with the various graphical methods of representing them. This portion will be found one of the most useful sections of the book by those designers, both professional and amateur, who find (as is frequently the case) that the exact conditions they are seeking are not given in tabulated or completely specific form in the valve data manuals. Those who have not been able to make use of the excellent families of valve curves that are given so freely in most manufacturers' valve data will find here all the necessary information for making the fullest use of them. The section on conversion factors, and the calculation of valve characteristics and operating conditions other than those published, is especially detailed, and the author is careful to point out the practical limitations of the simple methods used, and to indicate under what conditions more refined methods of estimation are necessary.

The chapter referred to gives a useful indication of the editor's approach to the mathematical side of design work, and to his idea of the relative importance to the reader of the purely mathematical approach, the graphical methods, and use of simple formulae. It is significant in this respect that of the 53 pages occupied by Chapter 22, only nine are devoted to "Mathematical Relationships." All through the book, indeed, mathematics is sparingly used. Of design formulae, the reader will find plenty, but this cannot be described as mathematics. Mathematics is essential in order to develop the formulae which the engineer must use for design purposes, while for a proper understanding of a good deal of radio theory, a grounding in mathematics is essential. But it is equally true to say that a great deal of detailed design work can be performed by those who are only sufficiently well versed in mathematics to substitute numerical values in formulae, and this is one of the basic ideas behind the "design," as it were, of the book itself.

An important feature of the volume is the way in which it is written, and here one can again discern the hand of the editor and principal author. Those who are just setting forth on the road to radio knowledge should not make the mistake of thinking that because the book contains a great deal of information that is useful only to those already possessing an advanced knowledge of the subject, it therefore has nothing to offer the student. Such is very far from being the case. The student will find much that is of immense interest to him, by way of presenting the technical background of many established circuit practices, and therefore of enabling him to view knowledgeably what will previously have been so many rules of thumb. At the same time, the book's readable style will enable him to absorb much new knowledge with the minimum of conscious effort.

Returning to Part I of the handbook, we come to Chapter 3, which deals with the testing of receiving valves. While many readers will have little occasion to test valves, everyone should find this chapter extremely valuable, as it cannot but increase the reader's understanding of the many problems that have to be overcome in successfully using valves, but which are often completely disregarded by their users. The fact that it is possible to disregard these problems, and still obtain successful operation, is not so much an indication that the difficulties and factors referred to do not exist, but rather a reflection of the tremendous amount of work that is put in by the makers of valves, for the express purpose of rendering them uncritical and reliable in operational use. However, a knowledge of these factors by the user of tubes can only be of benefit to him, for the material of this chapter contains the clues to innumerable cases of improper operation of circuits caused either by improper design, or by partially defective valves. Even if you never have to test a valve, this chapter is well worth reading.

Part II, containing chapters 4 to 11, is headed "General Theory and Components." It includes circuit and network theory—or rather the results obtained from such theory—since there is very little in the way of derivation. Here, especially, do the remarks above on the use of mathematics apply. Chapter 6 is a review of elementary mathematics, and contains all the simple algebraic and trigonometrical formulae needed by the radio engineer, without in any way attempting to act as an elementary text-book on mathematics. There is a chapter on transformers and iron-cored inductors, and this contains all the basic formulae and design methods to enable a newcomer to design his own. Again, it is worth emphasizing that even if one never intends to enter the field of transformer design, a treatment like this can be most valuable, because it enables the user of products designed by other people to know just what it is reasonable to expect from those products, having regard to their size, price, and intended application.

The portion of the book that will probably be awaited most eagerly is the section dealing wtih audio amplification. Mr. Langford-Smith is well known as an authority on high-fidelity reproduction, and if it is permissible to hazard a guess, this is his own favourite topic. His treatment of the problems connected with the realization of high-fidelity reproduction should help to clear the air of a good deal of loose writing (and loose talk) on this absorbing if somewhat controversial topic. He is unlike most writers on the subject, in that he does not press his own ideas on his readers with the semblance of authority, in cases where there is room only for personal opinion. At the same time, he is not averse to stating his own preferences or to giving the preference among engineers generally in matters which are not amenable to a clear-cut technical decision. His review of forms of distortion, and their measurement, together with an evaluation of the accuracy with which objective measurements of different kinds fit experimentally determined listeners' preferences, is particularly enlightening, and should help many high-fidelity enthusiasts, at all technical levels, to clarify their ideas on this rather confused subject. It is particularly pleasing, for instance, to note that he makes perfectly clear the fact that harmonic distortion and intermodulation distortion are simply two different manifestations of the same basic cause, viz., non-linearity, and that their measurements are only different methods of evaluating the extent to which non-linearity is present. The chapters dealing with audio work are particularly comprehensive, within their terms of reference, and those interested in gramophone reproduction will find a wealth of material to interest them.

It is a reviewer's privilege, and indeed his duty, to blame as well as to praise; there are few books for which it is impossible to find some criticism. It may seem slightly ridiculous to criticize a book such as this on

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Something About Television—The Shape of Things to Come

Early in December of last year (only a month ago, that is) the Minister of Broadcasting, the Hon. R. M. Algie, had something to say about our prospects of obtaining a television service in this country. It seems that, like the crusader's wife, he has not been idle, even if the results of his labours are not yet in full view. He was non-committal, of course, but it is at least significant that he did on this occasion say *something*, whereas before, impenetrable silence has been his shield and buckler. Like most public statements on TV to date, a good deal of what he said was concerned with explaining why it is so difficult to say anything on this vexed topic.

He did make it clear, however, that it would not be too much for us to expect a policy statement from the Government early in the New Year. Indeed, by the time these lines are published, that statement may have been made (although this does seem rather too much to expect). What it may contain, it is only possible to conjecture, but it does not seem likely that the answer will turn out to be "No Television!" If it were to be so, then the Minister could presumably have said this much at least several months ago.

Briefly, then, it looks as if news of TV might break quite soon. It may be that we will have to cope with television, and all that it implies rather sooner than some people think. Few technical men will not greet it with open arms, both as a source of absorbing new technical interests, and as a potential source of new business. It is certain that the manufacturing industry is taking a most commendably realistic view of TV. It will bring difficulties, everyone realizes that, but it will also open the gate to a wide field of commercial endeavour—an extension to the scope of the whole industry. "TV must come sooner or later," they say, "so let us have it as soon as possible, for we are convinced that its benefits will far outweigh its difficulties."

If the manufacturers are taking this view of the matter, there is no reason for anyone else in the industry to take a different one; the prospect of TV should encourage those who expect to have anything to do with it to start preparing for it now. It is not too soon to begin learning something of TV technique. Those who have made their preparations in advance will reap rich rewards when the time comes, and those who have not will be left lamenting. Make no mistake, we all have a great deal to learn about it. It is a good thing to read text-books, and articles in overseas periodicals, but that is a very far cry from a really practical preparation.

There are some people who have already realized this, and are taking active steps to see that if anyone is going to be caught with his television pants down (to put it metaphorically) it will not be they. In this category are several of the major radio manufacturers, who for some time have quietly been working towards the day when production of TV sets will begin. They realize that the sooner their technical staff is "genned up" the better. They see, too, that six months before a service starts will be no time to start educating their technical men or to begin ordering the special test equipment that their laboratories and factories will need. At least one of them is building some of this equipment now, thereby killing two birds with one stone, for there is nothing like practical work to familiarize a technician or engineer with the practical problems involved in a new type of work.

Then again, there is now in operation at the Seddon Memorial Technical College in Auckland, a course in television, designed to familiarize men who are already competent radio technicians with the theory and practice of TV. This course is meeting with considerable success, and nothing is more certain than that the forty or more students who have been taking the course will have cause to congratulate themselves on their enterprise and initiative. There will be many firms which will vie with each other in securing these men's services when the time comes.

For those who take an interest in these things, 1952 has been a landmark in TV development in this country, since it was during that year that the first actual transmissions of television pictures were made. This was in Christchurch, where Mr. B. T. Withers, who is a lecturer in electrical engineering at Canterbury University College, embarked on the construction of a television transmitting station as a project which would provide research material for honours students in electrical engineering. Not only have the first transmissions taken place, but material has been gathered for several original papers, and at least one technical discovery has been made which bids fair to have world-wide importance in TV circles.

The Wellington branch of the New Zealand Electronics Institute (Inc.) is also undertaking the construction of a complete TV transmitter, as a means of providing practical experience for its members, who are, of course, among those most keenly interested in the coming of TV.

All these things show that television is far from being a dead issue among those who are vitally concerned in it, or rather, who will be before very long, it is to be hoped. Accordingly, this journal has decided that it is time for some of our space to be applied to the technical aspects of TV. It is not intended to publish another of the serialized television instruction courses that have been so popular wtih overseas periodicals. Instead, we propose to run a series of articles describing the design of a unit capable of producing the standard synchronizing signal of the British television system. It is true that we do not yet know what standards New Zealand is to have, but from the viewpoint we are taking, this does not matter very much. All present-day systems are the same in principle, and differ only in detail, so that practical work based on any of them is just as valuable as if it were based on any of the others. We hope that many of our readers will agree with us that space devoted to such a series will be well spent, since the synchronizing circuits are the heart of any television system, and contain most of what is new to the radio man.

RADIO CLASSSES

For Operators, Engineers, Servicemen, commence on 2nd February, 1953. Enrolments received now.

NEW ZEALAND RADIO COLLEGE
26 HELLABY'S BUILDING - AUCKLAND, C.1

Abstract Service

(Continued from Page 27.)

An article on single side-bands; the terms 'balanced modulator," "phase-shift network," and "carrier suppression" are troublesome to beginners. For the first time, an analogy is made with the push-pull amplifier, and this provides the clue to an understanding of the terms. This article is a "must" for those who are having trouble with the theory.

—*QST* (U.S.A.), October, 1952, p. 38.

The device, usually known as "codan" for the suppression of intersignal noise, is basicaly a switch which cuts off the A.F. channel when no A.V.C. voltage is developed in the receiver. Operation of the device is quite simple—when the A.V.C. voltage is low or zero, a pentode draws plate current, and this biases a triode to and beyond cut-off so that it will not pass signals and normally functions as an ordinary amplifier. Full construction details given.

—*Ibid.*, p. 36.

TRANSMITTERS AND TRANSMITTING

A further article on non-synchronous time division with holding and random sampling—a system which sends samples by means of coded pulse groups sent at random times, and in the receiver is a "recognizer" which recognizes the pulses that belong to the different channels. A complete description of such a receiver is given, and possible applications of the system with a mathematical analysis.

—*Proceedings of the I.R.E.* (U.S.A.), September, 1952, p. 1079.

MISCELLANEOUS

Alessandro Volta gave to mankind the first practical source of electric current in his battery. His own description is extant, accompanied by his original drawings, very clear and detailed. His letters go beyond the mere presentation of scientific information and give an insight into the character and personality of the man himself. "As I finished to read my first paper," he wrote, "Bonaparte started to talk, exalted my discoveries, covered me with praise . . ." Indeed he was worthy of it.

Selective Calling System

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dialled, thus feeding the required audio tones into the tone-mixing amplifier.

Stolen Radios

(Continued from Page 36.)

Criminal Investigation Branch, Napier

H.M.V. 5-valve, "Perth" mantel model, serial No. 25400, brown plastic case with white lines, 13 in. x 9 in. x 7 in. Three tuning knobs.

Police Station, Christchurch

Pacemaker portable A.C. mains, D.C. battery, serial No. 67317. Dirty light tan cabinet 12 in. x 8¾ in. x 6 in. One dark red volume control and one tuning knob on top of set, silver speaker grille. Dial marked 55 to 150. Small spots grey paint on top of set.

RADIOS RECOVERED

Criminal Investigation Branch, Auckland

Mullard portable, serial No. 00502.

Criminal Investigation Branch, Palmerstoin North

Courier, serial No. 146756.

UNDERWATER TV PICTURES RELAYED FROM SHIP TO SHORE

Recently, in the Portsmouth area, the first trials were undertaken of ship-to-shore relaying of underwater television pictures. The equipment,, which was built by Messrs. Pye Ltd., Cambridge, was installed aboard the Admiralty salvage vessel *Reclaim*, and consisted of an underwater camera, and a 500-watt transmitter, both of which were operated from the ship's 240-volt 50-cycle supply. The sea-bed pictures, from a depth of some 100 feet, were clearly seen by viewers on the shore, sixteen miles away, in spite of adverse weather conditions. On shore, the signals from the ship-borne transmitter were frequency converted, and fed on closed circuit to a number of standard television receivers.

Book Reviews

(Continued from Page 46.)

the score of omissions, but the writer was surprised to find no reference whatever to tape recording or its circuitry. This is surprising in view of the fact that the references quoted in the very extensive bibliographies attached to each chapter extend into 1951. In view of the tremendous interest currently being taken in tape recording, this omission seems rather strange.

Another point on which the writer would criticize the book is that its interpretation of the words "Radio Receiver" is too closely confined. Indeed, if someone were to assume that the relative importance of receiver types were strictly in accordance with the space allotted them in this book, he would be sadly misled. For example, those portions which deal with any type of receiver other than domestic ones (A.M. or F.M.) are nothing short of meagre by comparison. The importance to the engineer of receivers other than purely domestic ones is really far greater than this handbook would lead one to suppose. Another subject which is very scantily treated is V.H.F., which is hardly touched upon except insofar as it affects F.M. receivers. However, in all fairness to the editor, it should be pointed out that his aim is clearly to deal comprehensively with domestic sets, and this he has done in a manner that can hardly have been bettered.

There is no space, even in a long review such as this one, to give even the briefest mention of much of the book. There are two features, however, that call for special commendation. They are the bibliography and the section devoted to tabulated reference information. There cannot be another book in existence which gives a fuller or more up-to-date list of the things that have been standardized in the radio industry in both Great Britain and America. On the reference side, it seems improbable that any important book or published paper dealing with any topic mentioned in the text, has been omitted. This is a notable achievement, as is the whole book, and the editor and his associates are much to be congratulated on it. It is to be hoped that this new edition has as much success as did its predecessor, and that Mr. Langford-Smith will consider the production of another handbook covering at least some of the subjects, such as television, which he has purposely omitted from this one. Should he do so, it will be well worth waiting for.

Battery Receiver

(Continued from Page 43.)

the normal manner, with the trimmers being used to align the high-frequency end, and the padder the low-frequency end. To judge from the results obtained from the prototype that was built in our laboratory, those who decide to tackle its construction will be more than agreeably surprised at what a battery set of modern design and construction can do. It is certain that a more up-to-the-minute design would be hard to find, so we wish all builders of it as good listening as we have had ourselves!